# Attachment 1

# Poll from October 8, 2015 BNL Community Advisory Council Meeting

# Five-Year CERCLA Review

Community Advisory Council Input
October 8, 2015

## October Meeting Survey

The Community Advisory Council members present at the October 8, 2015 meeting provided comments on the following questions. The comments are to serve as their input into the 2016 Five-Year Review. Additionally, some CAC members also provided written comments in response to the questions.

**1. What is your overall impression of BNL's cleanup and do you feel well informed about the cleanup activities and progress?**

Member Peskin, Brookhaven Retired Employee's Association, said his impression of the cleanup is extremely positive and he feels quite well informed about the activities and progress. He said he has been on the CAC as a member or alternate for about 10 years. Prior to that he was a stakeholder as an employee, he remembers the bad ole days when a group like this was sorely needed, he said the information flow is vital, these are no longer the bad ole days and said the Lab should be commended for the support they gave the CAC and the community in general.

Member Talbot, Middle Island Civic Association, said BNL's cleanup is and has been a central activity of attention to all operating departments. A large and continuing effort has been in place to keep the status of the cleanup in the forefront.

Member Chaudhry said he thinks there should be more of a focus on radioactivity and radionuclides and cleanup associated with them as opposed to the nonradioactive substances.

Member Sprintzen, Long Island Progressive Coalition, said excellent and yes!

**2. Are there any specific aspects of the cleanup that you feel should be of particular focus during the review? (e.g. RODs, cleanup goals, community input, etc.)**

Member Esposito, Citizens Campaign for the Environment, said just to make sure her comments were received, the 70-year timeline for Sr-90 plume that she is still unhappy about, since we have several years of monitoring, should be looked at to see if it can be shortened to less than 70 years. That was the longest remediation timeline that was approved for any of the areas at BNL so we should look at current and new data to see if it can be shortened. The timeline for the High Flux Beam Reactor should also be looked at to see if that can be shortened. She said we should not leave this for the next generation. She also wanted to focus on new technologies for denitrification for the sewage treatment plant.

Member Muether, Long Island Pine Barrens Society, asked if there was some kind of a report that compared what the CAC recommended and voted on for the cleanup many years ago and compared that to what was really done showing details about how the costs compared, time spent, and the degree of the cleanup. She wondered if there was a comparison done on the recommendations the CAC voted on.

Member Murdocco, Teachers Federal Credit Union, thinks it's important to keep a focus on making sure that, since the Lab is a science facility, it is easy to get lost and spiral down into a well of jargon and terms that the public isn't that familiar with outside of this group, make sure to keep that focus because it will be key for stakeholder relations.

Member Esposito added that she thinks that the Lab also needs to begin focusing on the Medical Reactor as there is not yet a D&D process established for it.

**3. Do you feel confident in BNL and DOE's management of the long-term cleanup operations for the site?**

Member Kaplan, Friends of Brookhaven, BNL the confidence in the management of the long-term cleanup, it's hard to say anything about DOE. We haven't been given as many presentations by DOE people here at the CAC concerning their input. You might say if I'm confident about BNL then by default one could say that about BSA and DOE, however, speaking for myself I don't feel that I could definitely give any comment about DOE's role and that's why I asked at our last meeting to see more input from DOE and from the regulators.

Member Peskin, said that you can only feel as confident as you are that you know who the management of the site will be. Directors change, strategic documents change. There was even a time when DOE didn't exist but Brookhaven Lab did. So you can't feel too confident because things can change, hopefully, for the better but you don't know.

Member Chaudhry said he might not agree with Member Kaplan regarding the DOE, but he gives them credit for what they are supposed to be doing. They are a management entity, not an implementing entity really, so they stay in the background. He gave a 9 out of 10 to BNL and DOE.

Member Heil, Town of Brookhaven Senior Citizens, said over the past few years BNL management has certainly earned our confidence and maybe along the same way DOE also because certainly BNL can't do much beyond the DOE approvals and funding. It's hard to predict the future. Changes of administration, changes of theories of life in the US, how future funding and availability of personnel, all those things that make up the program, how will they evolve, will they be there in the same way, hopefully it will continue, but it's always subject to change.

Karen Blumer said apparently DOE is really competent and diligent, however, in terms of trust and working or getting input from them here, we've noticed that everything is kept separate. Even on the nuclear discussion tonight everything is separated. So their performance on projects that we have seen and experienced here, input on the NEPA forms for example, our input was dismissed, therefore, our confidence level is shaken.

**4. Do you have any comments, suggestions, or recommendations regarding BNL / DOE's management and communications of the cleanup?**

Karen Blumer said she'd like to see a chart showing a summary of the progress overtime for all the cleanup projects so that it's not fragmented, so you can get a whole concept of what's happening. An easy chart that can be referred to. Progress was defined as where we are, as compared to where we were in the beginning.

Member Carlin, Huntington Breast Cancer Coalition, said he always felt like the website materials are organized for engineers and that's not for most people, it's easy to get lost. He'd like to see a high-level overview for the general public of all the different cleanup and oversight kinds of things happening at the Lab and liked what Member Blumer had said.

Member Martin also seconded Member Blumer's request for a chronological chart possibly broken down into different areas.

## Written Reponses

**Rite Biss**
**Lake Panamoka Civic Association**

The cleanup appears to be going well from the talks we have heard at the BNL meetings.

What are the permanent results or is it just in the local area discussed. Is this material in other local areas. Is the clean-up permanent or just temporary in the local area.

The cleanup appear to be going well, the quantities is down is it just in the local area. Did you choose the worst area correctly.

You have presented a reasonable discussion of local areas. What happens in the future.

**Karen Blumer / Michael Madigan**
**Individual**

Very good. Still work to do. Even though some/most of the work is in response to agency or CAC goading and/or presence, who cares? The job is progressing.

RODs. How do they get created? Please share specifics on the process. Sharing of modelling to give idea of overview time projected. Analysis presentation on the medical records of workers at BNL regarding health issues related to Lab activities.

Apparently competent and diligent, however based on BNL & DOE's performance and strength of input on the issue for example solar array/BP project's environmental review (those of us on the CAC who had issues were dismissed by BNL and DOE) raises issues and shakes my confidence (BNL/DOE) in their performance in all other areas.

Make RODs more transparent. Provide a chart showing summary progress for all clean-up from inception to present. (All Sr-90, denitrification, etc.) A similar chart to include modelling into the future. Include the RODs in the history timeline, when did they enact a ROD, when made changes, status now percent-wise.

**Wesley Chattaway**
**Ridge Civic Association**

From the review of the reports and the speakers, I feel better informed about cleanup activities and progress.

Records of Decisions would be important as it provides insight on what was done and how that decision was made.

From the review of the reports, yes, I feel confident in it.

Communication of the cleanup(s) to the local area (i.e. Ridge) should be more public. I have lived here for 13+ years and have never heard of any cleanups at the Lab. Not sure if local mailing/local newspaper inserts to help bring the info to the public.

**Isidore Doroski**
**Town of Riverhead**

Very pleased about the progressing clean up

Yes – the BGRR groundwater cleanup and monitoring.

Yes!

No.

**Adrienne Esposito**
**Citizens Campaign for the Environment**

I definitely feel well informed about the cleanup activities and appreciate BNL's willingness to provide follow up information to all CAC members who have questions or seek additional information. The cleanup appears to be going well and is being completed on the agreed upon timelines established in each of the RODs for individual sites. I would like to see Decommissioning and Decontamination of the HFBR and the Medical Reactor move forward.

I would like to see if the 70-year clean up timeline for the Strontium-90 plume could be dramatically reduced. I was against that allotment of time when the CAC voted and it still seems excessive today. We should be remediating these plumes and not leaving them for the next generation.

Yes, both BNL and DOE have done a terrific job of working hard to build community trust and transparency.

No.

**Don Garber**
**Emeritus**

Feels well informed, thinks the cleanup is a model. He feels confident in the management of the cleanup.

**Michael Giacomaro**
**East Yaphank Civic Association**

BNL has taken the initiative to search for the best method to handle each particular cleanup problem, they also would monitor the results to insure that they were getting the expected outcome and if not, why? Through the CAC and the presentations made by the cleanup groups and affiliated scientists, we were able to grasp a clear understanding of the activities taking place and progress being accomplished.

Comparing the results of the actions taken place against the desired outcome and what further needed to be done if not achieving the goals, BNL has consistently provided the CAC with county, state, and federal guidelines as to what our objectives should be.

Without a doubt, I feel confident in the management team of BNL & DOE regarding site cleanup operations.

Continue the good work on past indiscretions, having said that, I believe the CAC should be involved in evaluating BNL research that could potentially cause new leaks, environmental, or economic issues for the surrounding communities.

**Bonita Grandal**
**Lake Panamoka Civic Association**

Within my understanding of the cleanup I feel BNL has done a very good job of sampling, monitoring, and cleaning the Peconic River as well as ground water.

I would like to see all efforts made to bring residual contamination as close to 0.0% as possible. I feel this is a goal of Tim Green's.

Yes.

Community – through CAC and articles in community newsletters – especially those surrounding the Lab – should be implemented and continued.

**Helga Guthy**
**Wading River Civic Association**

Yes, and I appreciate the Lab's time & effort to keep us informed of on-going happenings.

Nothing specific – please continue your efforts.

Yes, very confident.

We thank both (BNL/DOE) for their work in keeping us informed & updated.

**James Heil**
**Town of Brookhaven Senior Citizens Office**

The BNL site cleanup program has gone well. After initial difficulties were resolved the response and subsequent monitoring were performed effectively. The information provided to the CAC has been well prepared, informative, and thorough. Responses to questions were complete and informative.

Perhaps a section could describe any new techniques, procedures, equipment or methods that evolved from the multi-year, multi-phase cleanup project that are now standard procedures. A discussion of the funding of all the cleanup phases might be interesting to show the extent of the cost and how proper management saves money.

Yes, assuming funding and staff are made available by the DOE.

A published history of the cleanup, written in layman's terms and placed in local libraries would be a long-term communication effort to balance the negatives generated by the local media in response to incidents at BNL. The history could present the causes, the technical responses, costs, effectiveness, CAC, etc.

**Ed Kaplan**
**Friends of Brookhaven**

BNL has been quite transparent in describing its cleanup activities and progress. Based on data presented to the CAC it appears as though these cleanups have been quite successful.

The Review should focus on the extent to which BNL has sought community input and actually incorporated it into cleanup goals & programs.

BNL staff has demonstrated their commitment to environmental protection.

It would be interesting to learn more about the actual interactions between BNL/DOE staff & regulators. The CAC could benefit from hearing directly from regulators concerning BNL/DOE environmental programs.

**Ray Keenan**
**Affiliated Brookhaven Civic Organizations**

The cleanup appears to be progressing as required. The CAC receives an adequate amount of information regarding the cleanup.

The cleanup goals and timelines should be reviewed.

Yes, they've demonstrated a commitment to the cleanup and the ability to effectuate the plan.

I would like to see the cleanup progress publicized to the extent it is "newsworthy." Perhaps additional media outreach would be helpful – and good for P.R.

**Reiny Schuhmann**
**American Physical Society**

As a new full member of CAC (who had minimal interaction as an alternate over a few years) my impressions are of course somewhat limited. I have however kept abreast of BNL cleanup activity for many years, since environmental issues are important to me, since I work across the street from the Lab, and because as a physicist I very much want BNL to thrive. My overall impression of BNL's cleanup activity is quite positive. I am particularly impressed by the efforts to remediate VOC's in the groundwater, which to me are more pernicious than the radioisotope issues that grab so much public attention.

It seems to me that communication to the community is the most difficult issue, so it should get the most attention. One runs into the usual problem—the community wants to hear that everything has been cleaned up to the point that it is "100% safe," while the scientific perspective is based on the notion of meeting acceptable limits, to make things "as safe as one can make them." Again, I am just learning how CAC operates so my input is based on limited experience.

Yes, and I hope to continue to work with CAC to maintain my confidence.

Not at present.

**Tom Talbot**
**Middle Island Civic Association**

BNL's cleanup is and has been a central activity of attention to all operating departments. A large and continuing effort has been in place to keep the status of the cleanup in the forefront.

Cleanup goals have been openly determined and shared with community representatives via the Community Advisory Council for timely communication. All aspects of the cleanup program are deemed vital to ensure that no segment is overlooked in the final analysis.

Based on past and present performance, BNL and DOE's management has been openly candid regarding all aspects of past, current, and potential future leaks. Deviating from the past performance would be significantly detrimental to the facility.

Initiate a periodic status report to the general public describing the scope of the past, present, and planned future of the leak related program.

**Ron Trotta**
**Brookhaven Coalition of Chambers of Commerce**

I feel BNL has made the appropriate efforts to keep us informed about the cleanup activities and progress.

Community input and cleanup goals.

Since, I've only had limited time being exposed to information on the cleanup, I can only comment on that. So far I feel the long-term cleanup operations are going in a positive direction.

Just please keep the information coming so I can further educate the public.

**Paul Ziems**
**Coram Civic Association**

I believe that BNL is doing a great job of cleaning up the whole BNL site. In addition to the cleanups brought about by various experiments which were responsible for radioactive spills and mercury contamination, they also had to clean up pollution form prior uses of the property as a military base.

I have no concerns regarding the cleanup efforts, BNL personnel have been addressing all the polluted sites inside of the property. It was encouraging to see that when they were cleaning up the mercury pollution of the Peconic River that they also removed invasive plants along the river bank.

I am very confident that BNL management is committed to site cleanup for the long term. They have experience and plans showing cleanup efforts in progress with projected end dates for the cleanup and site monitoring after the cleanup.

No further comments at this time.

# Attachment 2

# 2015 BNL Groundwater Status Report, BNL 2016 (CD Version)

(To be included in public availability version)

# Attachment 3

# Inspection Checklists

# BNL Five-Year Review Site Inspection Checklist

| I. SITE INFORMATION | |
|---|---|
| **Site name:** Brookhaven National Laboratory | **Date(s) of inspection:** 4/30/15 through 11/3/15 |
| **Location and Region:** Upton, NY, EPA Region 2 | **EPA ID:** NY7890008975 |
| **Agency, office, or company leading the five-year review:** Brookhaven Science Associates (BSA) for the U.S. Department of Energy (DOE) | **Weather/temperature:** NA |

**Remedy Includes**: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other_Annual private well testing
- ☒ Monitored natural attenuation
- ☒ Groundwater containment
- ☐ Vertical barrier walls

______________________________________________________________________

______________________________________________________________________

**Attachments:** ☒ Inspection team roster attached ☐ Site map attached

**II. INTERVIEWS** (Check all that apply)

1. **O&M site manager** _ Bill Dorsch, Groundwater Protection Group (GPG) Manager_
Interviewed ☒ at site ☒ at office ☐ by phone Phone no. _344-5186
Problems, suggestions; ☐ Report attached _Work with on a daily basis and discuss issues weekly. ___

2. **O&M staff** Vinnie Racaniello, Eric Kramer, Adrian Steinhauff, Project Manager and Field Engineers
Interviewed ☒ at site ☒ at office ☐ by phone Phone no. 344-5436, 8226, 2363______________
Problems, suggestions; ☐ Report attached Work with on a daily basis and discuss issues weekly.____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ___EPA, NYSDEC, NYSDOH, SCDHS, DOE _________________________
Contact ____________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☒ Report attached See interview records.
______________________________________________________________________

Agency ____________________________
Contact ____________________________ ___________________ ________ ____________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________________________
______________________________________________________________________

4. **Other interviews** (optional) ☐ Report attached.

| III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply) | |
|---|---|
| 1. | **O&M Documents**<br>☒ O&M manual ☒ Readily available ☒ Up to date ☐ N/A<br>☒ As-built drawings ☒ Readily available ☒ Up to date ☐ N/A<br>☐ Maintenance logs ☐ Readily available ☐ Up to date ☐ N/A<br>Remarks: O&M Manuals have been updated and are available in the treatment buildings, Bldg. 462 Project File, and on the internal GPG website. However, the manuals were missing from two off-site systems during the inspection. They were immediately replaced. The as-built drawings are available through the GPG and copies are available through Facility & Operations database. |
| 2. | **Site-Specific Health and Safety Plan** ☒ Readily available ☒ Up to date ☐ N/A<br>☒ Contingency plan/emergency response plan ☒ Readily available ☒ Up to date ☐ N/A<br>Remarks: The groundwater treatment systems have a contingency/emergency plan in their O&M Manuals. Project maintenance/repair on the remediation systems is performed in accordance with SBMS Work Planning and Control requirements. Contractors also perform work in accordance with their H&S Plan and Phase Hazard Analysis.<br>______________________________________________________________________ |
| 3. | **O&M and OSHA Training Records** ☒ Readily available ☒ Up to date N/A<br>Remarks _Worker training records are available on the BNL training website database. __ |
| 4. | **Permits and Service Agreements**<br>☒ Air discharge permit ☒ Readily available ☒ Up to date ☐ N/A<br>☒ Effluent discharge ☒ Readily available ☒ Up to date ☐ N/A<br>☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☐ N/A<br>☒ Other permits: Peconic ☒ Readily available ☒ Up to date ☐ N/A<br>Remarks: DEC air and SPDES equivalency permits in place for all treatment systems, as appropriate. Peconic River On-site and Off-site Supplemental Sediment Removal permit is in place. ____ |
| 5. | **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A<br>Remarks: Passive gas venting only. Landfill gas testing results available in the Annual Reports.______ |
| 6. | **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date ☐ N/A<br>Remarks: Groundwater monitoring data is made available via the Quarterly System Operations Reports, as well as the Annual Groundwater Status Report. _________________ |
| 7. | **Discharge Compliance Records**<br>☒ Air ☒ Readily available ☒ Up to date ☐ N/A<br>☒ Water (effluent) ☒ Readily available ☒ Up to date ☐ N/A<br>Remarks: Discharge Monitoring Reports (DMRs) for the treatment systems with SPDES equivalency permits are issued monthly to the DEC and are available in the GPG Project Files. Air compliance records are documented in the Annual Groundwater Status Reports. ____________________ |
| 8. | **Daily Access/Security Logs** ☒ Readily available ☐ Up to date ☐ N/A<br>Remarks_Operating data sheets for the groundwater systems are available at the treatment buildings and the GPG Project files. |
| 9. | **Comments** ______________________________________________________________<br>______________________________________________________________________<br>______________________________________________________________________ |

| IV. O&M COSTS |
|---|

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other: Responsibility for managing BNL's Long Term Stewardship lies with the Environmental Protection Division's (EPD) GPG. ___

2. **O&M Cost Records**

☒ Readily available ☒ Up to date
☒ Funding mechanism/agreement in place

Total annual cost by year for review period if available

| | | | | | |
|---|---|---|---|---|---|
| From | 10/10 Date | To | 9/11 Date | Avg. Annual of $293K Total cost | ☒ Breakdown attached |
| From | 10/11 Date | To | 9/12 Date | Avg. Annual of $207K Total cost | ☒ Breakdown attached |
| From | 10/12 Date | To | 9/13 Date | Avg. Annual of $159K Total cost | ☒ Breakdown attached |
| From | 10/13 Date | To | 9/14 Date | Avg. Annual of $179K Total cost | ☒ Breakdown attached |
| From | 10/14 Date | To | 9/15 Date | Avg. Annual of $159K Total cost | ☒ Breakdown attached |

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: No unusually high O&M costs identified. The annual costs for each system from FY2011 through FY2015 is identified in the Five-Year Review.

| V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A |
|---|
| **A. Fencing** |
| 1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☒ N/A<br>Remarks: _ |
| **B. Other Access Restrictions** |
| 1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A<br>Remarks: Identification signs are in place for all of the on-site and off-site groundwater treatment systems. DOE notification signs are in place for all treatment facilities located beyond BNL's property boundary. There are BNL security personnel on the BNL property 24 hours per day. For the systems located beyond the BNL boundaries, the buildings are secured with a lock and alarms. The alarms are transmitted to an alarm company, then BNL is notified. Restricted use signs are posted at former soil cleanup areas including the Former Hazardous Waste Management Facility, former Meadow Marsh, Landfills, Ash Pit, former Chemical Holes, Bldg. 96, Bldg. 650 Sump Outfall, and Bldg. 811.<br>______________________________ |
| **C. Institutional Controls (ICs)** |
| 1. **Implementation and enforcement**<br>Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A<br>Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A<br><br>Type of monitoring (*e.g.*, self-reporting, drive by): Routine walkdown inspections of landfills, former soil cleanup areas, and groundwater treatment systems.<br>________________________________________<br>Frequency: Varies from approximately 2x/week for treatment systems, monthly for landfills, semi-annual former soil cleanup areas.<br>______________________________________________________________________<br>Responsible party/agency: BSA under contract with DOE.<br>___________________________________________________________<br>Contact: William Dorsch — BSA GPG Manager — 2/24/16 — (631) 344-5186<br>Terri Kneitel — DOE Project Manager — 2/24/16 — (631) 344-2112<br>Name — Title — Date — Phone no.<br><br>Reporting is up-to-date ☒ Yes ☐ No ☐ N/A<br>Reports are verified by the lead agency ☒ Yes ☐No ☐ N/A<br><br>Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A<br>Violations have been reported ☐ Yes ☒ No ☐ N/A<br>Other problems or suggestions: ☐Report attached<br>Remarks: There are eight access agreements in place among BSA/DOE and various property owners to allow for operation of BNL's groundwater remediation systems for plumes that have migrated beyond the BNL property. Each agreement has terms and conditions that must be adhered to. A license agreement is also in place among BSA/BHSO/Suffolk County for the supplemental sediment cleanup for the Peconic River in 2010/2011, followed by continued monitoring.____________ |
| 2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A<br>Remarks: The Land Use Controls Management Plan and institutional controls website and fact sheets continue to be updated, as needed to reflect the most recent IC's for each project. ___ |

| D. General | |
|---|---|
| 1. | **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident<br>Remarks_There has been some vandalism in the past at some of the treatment systems and manholes located near and beyond the BNL property boundary. However, additional precautions have been implemented for the off-site systems such as alarm systems to help minimize the potential risk. ____________ |
| 2. | **Land use changes on site** ☒ N/A<br>Remarks: None________________________________________________________ |
| 3. | **Land use changes off site** ☒ N/A<br>Remarks: None__________________________________________________ |
| | **VI. GENERAL SITE CONDITIONS** |
| **A. Roads** ☒ Applicable ☐ N/A | |
| 1. | **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A<br>Remarks_____________________________________________________________________________ |
| **B. Other Site Conditions** | |
| | Remarks: ________________________________________________________________ |

| VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A | | |
|---|---|---|
| **A. Project OU I AOC 2F** Ash Pit 11/2/15 | | |
| 1. | **Soil Excavation Complete** ☒ Yes ☐ No<br>Remarks ____________ | |
| 2. | **S&M Documents**<br>☒ S&M Plan ☒ Readily available ☒ Up to date ☐ N/A<br>☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A<br>☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A<br>Remarks: Final Closeout Report for the Ash Pit OU I AOC 2F, dated 2/5/04. Section 4.0 of the Closeout Report identifies LTS requirements (i.e., annual inspection). _ | |
| 3. | **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident<br>Areal extent ____________ Depth____________<br>Remarks: None<br>____________ | |
| 4. | **Erosion** ☐ Location shown on site map ☒ Erosion not evident<br>Areal extent____________ Depth____________<br>Remarks: None.<br>____________ | |
| 5. | **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress<br>☒ Trees/Shrubs (indicate size and locations on a diagram)<br>Remarks: Trees surround the pit area. Excellent native grass growth on pits.<br>____________ | |
| 6. | **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident<br>☐ Wet areas ☐ Location shown on site map Areal extent____________<br>☐ Ponding ☐ Location shown on site map Areal extent____________<br>☐ Seeps ☐ Location shown on site map Areal extent____________<br>☐ Soft subgrade ☐ Location shown on site map Areal extent____________<br>Remarks: None.<br>____________ | |
| 7. | **Monitoring Wells** (within the excavated area)<br>☒ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☒ Good condition<br>☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A<br>Remarks____________<br>____________ | |
| 8. | **Other Site Conditions** | |
| | Remarks: Inspection attendees include W. Dorsch, R. Howe, D. Paquette, M. Hanson ____ | |

| VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A |
|---|
| **A. Project OU I AOC 8** Meadow Marsh 10/27/15 |
| 1. **Soil Excavation Complete** ☒ Yes ☐ No<br>Remarks |
| 2. **S&M Documents**<br>☒ S&M Plan ☒ Readily available ☒ Up to date ☐ N/A<br>☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A<br>☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A<br>Remarks: Final Closeout Report for the Meadow Marsh OU I AOC 8, dated 2/6/04. Section 4.0 of the Closeout Report identifies LTS requirements (i.e., ecological monitoring and inspection for Tiger Salamanders). Institutional controls are also identified in the Report. |
| 3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident<br>Areal extent Depth<br>Remarks |
| 4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident<br>Areal extent Depth<br>Remarks |
| 5. **Vegetative Cover** ☒ Grass ☐ Cover properly established ☒ No signs of stress<br>G Trees/Shrubs (indicate size and locations on a diagram)<br>Remarks: Native grasses planted adjacent to the pond. |
| 6. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident<br>☐ Wet areas ☐ Location shown on site map Areal extent<br>☒ Ponding ☐ Location shown on site map Areal extent<br>☐ Seeps ☐ Location shown on site map Areal extent<br>☐ Soft subgrade ☐ Location shown on site map Areal extent<br>Remarks: The remediated area is a pond for the Tiger Salamanders. Due to the drought, the water level in the pond is below average. |
| 7. **Monitoring Wells** (within the excavated area)<br>☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition<br>☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A<br>Remarks |
| 8. **Other Site Conditions** |
| Remarks: Inspection attendees include R. Howe, J. Burke, M. Chuc. |

**VII. SOIL CLEANUP REMEDIES** ☒ Applicable ☐ N/A

**A. Project OU I AOC 6** Bldg. 650 Sump Outfall 10/20/15

1. **Soil Excavation Complete** ☒ Yes ☐ No

   Remarks ______________________________

2. **S&M Documents**

   ☒ S&M Plan ☒ Readily available ☒ Up to date ☐ N/A

   ☒ Completion/Closeout Report ☒ Readily available ☐ Up to date ☐ N/A

   ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A

   Remarks: Draft Final Closeout Report for AOC 6 Bldg. 650 Sump and Sump Outfall, dated 1/02.

3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident

   Areal extent______________ Depth____________

   Remarks: The entire area is graded and a drainage swale exists that routes surface runoff to the ponded sump. The pond is dry at this time.

4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident

   Areal extent______________ Depth____________

   Remarks: ______________________________

5. **Vegetative Cover** ☒ Grass ☐ Cover properly established ☒ No signs of stress

   ☒ Trees/Shrubs (indicate size and locations on a diagram)

   Remarks: Many trees surround the sump. Good native grass cover.

6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident

   ☐ Wet areas ☐ Location shown on site map Areal extent______________

   ☐ Ponding ☐ Location shown on site map Areal extent______________

   ☐ Seeps ☐ Location shown on site map Areal extent______________

   ☐ Soft subgrade ☐ Location shown on site map Areal extent______________

   Remarks: Pond is Tiger Salamander habitat

7. **Monitoring Wells** (within the excavated area)

   ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

   ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

   Remarks:

8. **Other Site Conditions**

   Remarks: Inspection attendees include R. Howe, J. Burke, V. Racaniello. Previously installed fence partially surrounds the former sump outfall (no restrictions for entering area). ________________

**VII. SOIL CLEANUP REMEDIES** ☒ Applicable ☐ N/A

**A. Project OU I AOC 16S** Landscape Soil Areas 10/26/15

1. **Soil Excavation Complete** ☒ Yes ☐ No

   Remarks ______________________________

2. **S&M Documents**

   ☒ S&M Plan ☒ Readily available ☒ Up to date ☐ N/A

   ☒ Completion/Closeout Report ☒ Readily available ☐ Up to date ☐ N/A

   ☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A

   Remarks: Final Closeout Report for AOC 16 Landscape Soils, dated 4/10/01.

3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident

   Areal extent______________ Depth____________

   Remarks______________________________

4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident

   Areal extent______________ Depth____________

   Remarks______________________________

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress

   G Trees/Shrubs (indicate size and locations on a diagram)

   Remarks______________________________

6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident

   ☐ Wet areas ☐ Location shown on site map Areal extent______________

   ☐ Ponding ☐ Location shown on site map Areal extent______________

   ☐ Seeps ☐ Location shown on site map Areal extent______________

   ☐ Soft subgrade ☐ Location shown on site map Areal extent______________

   Remarks______________________________

7. **Monitoring Wells** (within the excavated area)

   ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

   ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

   Remarks______________________________

8. **Other Site Conditions**

   Remarks: Inspection attendees include R. Howe, J. Burke, D. Paquette.

| VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A | |
|---|---|
| **A. Project OU I AOC 1** Hazardous Waste Management Facility (HWMF)/Waste Loading Area 10/19/15_ | |
| 1. | **Soil Excavation Complete** ☒ Yes ☐ No<br>Remarks: |
| 2. | **S&M Documents**<br>☒ S&M Plan ☒ Readily available ☒ Up to date ☐ N/A<br>☒ Completion/Closeout Report ☒ Readily available ☐ Up to date ☐ N/A<br>☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A<br>Remarks: The Soil and Peconic River Surveillance and Maintenance Plan, dated March 2013. The Final Closeout Report for the Former Hazardous Waste Management Facility, dated 9/29/05. Final Completion Report for the HFBR Waste Loading Area, dated July 2009. |
| 3. | **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident<br>Areal extent______________ Depth____________<br>Remarks: |
| 4. | **Erosion** ☐ Location shown on site map ☒ Erosion not evident<br>Areal extent______________ Depth____________<br>Remarks: __ |
| 5. | **Vegetative Cover** ☒ Grass ☒ Cover properly established ☐ No signs of stress<br>☒ Trees/Shrubs (indicate size and locations on a diagram)<br>Remarks: Significant grass, shrubs, trees present. |
| 6. | **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident<br>☐ Wet areas ☐ Location shown on site map Areal extent__________<br>☐ Ponding ☐ Location shown on site map Areal extent______________<br>☐ Seeps ☐ Location shown on site map Areal extent______________<br>☐ Soft subgrade ☐ Location shown on site map Areal extent______________<br>Remarks: Vegetation is well established. The wetland area immediately to the northwest of the FHWMF is dry due to the drought. _____ |
| 7. | **Monitoring Wells** (within the excavated area)<br>☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition<br>☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A<br>Remarks: |
| 8. | **Other Site Conditions** |
| | Remarks: Inspection attendees include R. Howe, J. Burke, D. Paquette.<br>Some of the vegetation in the yard was mowed as part of the Sr-90 groundwater characterization effort. GPG is coordinating the Geoprobe work in the FHWMF and WLA for the Sr-90 groundwater characterization. The fixed contamination signs on the foundations are in good condition and legible. The annual survey of the fixed contamination on several of the concrete foundations was performed in July 2015 by BNL RadCon. No loose contamination detected. Waste Management has a Radioactive Material Storage Area (RMA) just outside the main gate for the temporary storage of Bldg. 811 D&D project rad waste. The Waste Loading Area (WLA) has good vegetative growth. The WLA is currently being used for waste staging/rail loading for the Bldg. 811 D&D project. All RMAs are properly posted. All gates have signs and are locked. |

| VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A |
|---|
| **A. Project OU V AOC 30** Peconic River 11/3/15 |
| 1. **Soil Excavation Complete** ☒ Yes ☐ No<br>Remarks: The original 2004/2005 is complete, and supplemental sediment remediation of three small areas was also completed in 2010/2011. Discussions underway with the regulators for supplemental remediation of Area WC-06. ___________________ |
| 2. **S&M Documents**<br>☒ S&M Plan ☒ Readily available ☒ Up to date ☐ N/A<br>☒ Completion/Closeout Report ☒ Readily available ☐ Up to date ☐ N/A<br>☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A<br>Remarks: The Soil and Peconic River Surveillance and Maintenance Plan, dated March 2013. Surface water, sediment, and fish monitoring requirements are identified in this Plan.<br>Final Closeout Report for Peconic River Remediation Phases 1 and 2, 8/25/05, and Supplemental Remediation Closeout Report, dated March 2012. |
| 3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident<br>Areal extent______________ Depth____________<br>Remarks: __________ |
| 4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident<br>Areal extent______________ Depth____________<br>Remarks__________________________________________________________________________ |
| 5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress<br>☒ Trees/Shrubs (indicate size and locations on a diagram)<br>Remarks: |
| 6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident<br>☐ Wet areas ☐ Location shown on site map Areal extent______________<br>☒ Ponding ☐ Location shown on site map Areal extent: Area B_______<br>☒ Seeps ☐ Location shown on site map Areal extent______________<br>☒ Soft subgrade ☐ Location shown on site map Areal extent______________<br>Remarks: The onsite portion of the river is dry from the STP to Station HQ. There is no flow upstream of the former STP outfall at station HE. |
| 7. **Monitoring Wells** (within the excavated area)<br>☒ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☒ Good condition<br>☐ Evidence of leakage at penetration ☒ Needs Maintenance ☐ N/A<br>Remarks: River piezometer near Area WC-06 will be removed following planned excavation. |
| 8. **Other Site Conditions** |
| Remarks: Inspection attendees include T. Green, R. Howe, W. Dorsch, M. Hanson.<br>There is significant vegetation growth at all 2011 cleanup areas. Gates along E. Boundary path and gate at North Street/Z-Path are locked. |

**VII. SOIL CLEANUP REMEDIES** ☒ Applicable ☐ N/A

**A. Project OU I AOC 10** Building 811 UST and Soils 10/20/15______________________

1. **Soil Excavation Complete** ☒ Yes ☐ No

Remarks: Excavation complete in 2005. Work is ongoing for the demolition of Bldg. 810/811, and associated soil excavation.

2. **S&M Documents**

☒ S&M Plan ☒ Readily available ☒ Up to date ☐ N/A
☒ Completion/Closeout Report ☒ Readily available ☐ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A

Remarks: Final Closeout Report for AOC 10 Waste Concentration Facility, 9/05.
The Soil and Peconic River Surveillance and Maintenance Plan, dated March 2013.

3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident

Areal extent______________ Depth____________

Remarks: Soil excavation in progress.

4. **Erosion** ☐ Location shown on site map ☐ Erosion not evident

Areal extent______________ Depth____________

Remarks: _Hay bales and silt fence in place for erosion control during excavation._________________

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress

☐ Trees/Shrubs (indicate size and locations on a diagram)

Remarks: Native grasses established. ____________

6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident

☐ Wet areas ☐ Location shown on site map Areal extent______________
☐ Ponding ☐ Location shown on site map Areal extent______________
☐ Seeps ☐ Location shown on site map Areal extent______________
☐ Soft subgrade ☐ Location shown on site map Areal extent______________

Remarks____________________________________________________________

7. **Monitoring Wells** (within the excavated area)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☒ Needs Maintenance ☐ N/A

Remarks: All of the BNL monitoring wells are secured and locked.

8. **Other Site Conditions**

Remarks: Inspection attendees include V. Racaniello, R. Howe, J. Burke.

| VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A |
|---|
| **A. Project OU III AOC 26B** Building 96 10/27/15________________________ |
| 1. **Soil Excavation Complete** ☒ Yes ☐ No<br>Remarks: PCB soil excavation complete in 2005. VOC source area excavation was completed in 2010. |
| 2. **S&M Documents**<br>☒ S&M Plan ☒ Readily available ☐ Up to date ☐ N/A<br>☒ Completion/Closeout Report ☒ Readily available ☒ Up to date ☐ N/A<br>☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A<br>Remarks: OU III Building 96 PCB Soil (AOC 26B) Excavation Closeout Report, 3/05.<br>Building 96 Soil Excavation and Disposal Closure Report, dated January 2011.<br>The OU I Soils and OU V Long-Term Monitoring and Maintenance Plan, dated May 2006. |
| 3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident<br>Areal extent_______________ Depth_____________<br>Remarks:<br>_________________________________________________________________________________ |
| 4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident<br>Areal extent_______________ Depth_____________<br>Remarks: ________________________ |
| 5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress<br>☐ Trees/Shrubs (indicate size and locations on a diagram)<br>Remarks: Good vegetative growth. _____________ |
| 6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident<br>☐ Wet areas ☐ Location shown on site map Areal extent_______________<br>☐ Ponding ☐ Location shown on site map Areal extent_______________<br>☐ Seeps ☐ Location shown on site map Areal extent_______________<br>☐ Soft subgrade ☐ Location shown on site map Areal extent_______________<br>Remarks____________________________________________________________________________<br>_________________________________________________________________________________ |
| 7. **Monitoring Wells** (within the excavated area)<br>☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition<br>☐ Evidence of leakage at penetration ☒ Needs Maintenance ☐ N/A<br>Remarks: All of the BNL monitoring wells are secured and locked. |
| 8. **Other Site Conditions** |
| Remarks:<br>Inspection attendees include R. Howe, J. Burke, M. Chuc. |

| VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A |
|---|
| **A. Project OU I AOC 2B,C** Chemical/Animal/Glass Holes 10/22/15________________________ |
| 1. **Soil Excavation Complete** ☒ Yes ☐ No<br>Remarks: Soil excavation complete in 2005. |
| 2. **S&M Documents**<br>☒ S&M Plan ☒ Readily available ☒ Up to date ☐ N/A<br>☒ Completion/Closeout Report ☒ Readily available ☐ Up to date ☐ N/A<br>☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A<br>Remarks: Animal/Chemical Pits and Glass Holes Remedial Action Closure Report, 10/97.<br>Animal/Chemical Pits and Glass Holes Remedial Action Closure Report Addendum, 9/05.<br>The OU I Soils and OU V Long-Term Monitoring and Maintenance Plan, dated May 2006. |
| 3. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident<br>Areal extent_______________ Depth____________<br>Remarks: None.<br>_______________________________________________________________________________ |
| 4. **Erosion** ☐ Location shown on site map ☒ Erosion not evident<br>Areal extent_______________ Depth_<1 foot___________<br>Remarks: None.___________ |
| 5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress<br>☐ Trees/Shrubs (indicate size and locations on a diagram)<br>Remarks: Significant native grasses and pines established. ____________ |
| 6. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident<br>☐ Wet areas ☐ Location shown on site map Areal extent______________<br>☐ Ponding ☐ Location shown on site map Areal extent______________<br>☐ Seeps ☐ Location shown on site map Areal extent______________<br>☐ Soft subgrade ☐ Location shown on site map Areal extent______________<br>Remarks_______________________________________________________________________<br>_______________________________________________________________________________ |
| 7. **Monitoring Wells** (within the excavated area)<br>☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition<br>☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A<br>Remarks: None. |
| 8. **Other Site Conditions** |
| Remarks:<br>Inspection attendees include R. Howe, J. Burke, V. Racaniello, D. Paquette. |

Location (AOC): Sewage Treatment Plant
Date of Inspection: 11/3/15_____________________________________
Name of Inspector(s): R. Howe, W. Dorsch, T. Green, M. Hanson
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 2x/yr) ☐Heavy Rainfall ☐Reported Incident

**A. Inspection Checklist**

| Component | Observed Condition: Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|
| **1. Soil Covers/Wetlands:** | | | | | | |
| Vegetation (e.g. grass) | | X | | | | X |
| Soil (Cap/Cover/Fill) | X | | | | No erosion evident | X |
| Other: ________________________ | | | | | | |
| **2. Drainage Structures:** | | | | | | |
| Standing Water | | | | X | | X |
| Toe Drain | | | | X | | X |
| Drainage Channels | | | | X | | X |
| French Drains/Outfalls | | | | X | | X |
| Subsurface Drainage | X | | | | | X |
| Pipes/Outfalls | | | | X | | X |
| Manholes | X | | | | | X |
| Filter Berms | | | | X | | X |
| Roof Drains | X | | | | | X |
| Recharge Areas | | | | | | |
| Other: ____________ | | | | | | |
| **3. Monitoring System:** | | | | | | |
| Soil Gas Wells | | | | X | | X |
| Groundwater Wells | X | | | | | X |
| Gas Vents | | | | X | | X |
| Other: ________________________ | | | | | | |
| **4. Site Access:** | | | | | | |
| Asphalt Access Road | | | | X | | X |
| Crushed-concrete Access Road | | X | | | | X |
| Fence | | | | X | | X |
| Gates/locks | | | | X | | X |
| Radiological Postings | | | | X | | X |
| Other: | | | | | | |

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: __________

**B. Description of Other Observations**

Observed Conditions/Recommendations: I called Rich Izzo (x2982) at the STP to let him know we'll be performing an inspection of the STP sand filters. There was no flow from the former STP outfall since the effluent discharge was changed in September 2014 to groundwater via the new recharge basins. There was no flow upstream at station HE. No erosion of soil cover is evident on the sand filter berms or sludge drying beds remediated areas. No unauthorized work visible at the abandoned sewer line area. The former outfall Building 580 which was used for UV disinfection, was demolished in October 2015. LUIC Fact Sheet Changes: Fix link to reports.

Location (AOC): Current Landfill and Wooded Wetland______________________
Date of Inspection: 10/26/15___________________________________
Name of Inspector(s): R. Howe, J. Burke, D. Paquette
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 2x/yr) ☐ Heavy Rainfall ☐ Reported Incident

**A. Inspection Checklist**

| Component | Observed Condition: Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|
| **1. Landfill Cap/Wetlands:** | | | | | | |
| Vegetation (e.g. grass) | X | | | | | X |
| Soil (Cap/Cover/Fill) | | X | | | Fill-in burrow/ruts | |
| Other: ________________________ | | | | | | |
| **2. Drainage Structures:** | | | | | | |
| Standing Water | X | | | | Dry | X |
| Toe Drain | X | | | | | X |
| Drainage Channels | X | | | | Some vegetation | |
| French Drains/Outfalls | | | | X | | X |
| Subsurface Drainage | | X | | | | X |
| Pipes/Outfalls | | | | X | | X |
| Manholes | | | | X | | X |
| Berms | | | | X | | X |
| Roof Drains | X | | | | | X |
| Recharge Areas | | | | | | |
| Other: ________________________ | | | | | | |
| **3. Monitoring System:** | | | | | | |
| Soil Gas Wells | X | | | | Minimal weeds | X |
| Groundwater Wells | X | | | | | X |
| Gas Vents | X | | | | No nests or damage | X |
| Other: __ | | | | | | |
| **4. Site Access:** | | | | | | |
| Asphalt Access Road | X | | | | Seal asphalt cracks | |
| Crushed-concrete Access Road | | | | X | | X |
| Fence | X | | | | | X |
| Gates/locks | X | | | | Good | X |
| Radiological Postings | | | | X | | X |
| Other: Stairs access to cap | X | | | | | X |

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: _ ________________________________________________

**B. Description of Other Observations**

Observed Conditions/Recommendations: The grass on the cap was cut a few weeks ago. An area of minor erosion on the west slope and a large animal burrow on the south east slope needs to be filled-in and seeded by Facilities and Operations (F&O). The burrow appears to be about 12 inches in depth. Vegetation in the south culvert needs to be sprayed, and other vegetation along the west road mechanically cut. The Wooded Wetland was dry. Signs in place and all gates locked. Replaced the rusted lock on the SW gate following the spring inspection. LUIC Factsheet Changes: No changes for Current Landfill or Wooded Wetlands

Location (AOC): Former Landfill Area (includes the former and interim landfills and slit trench)
Date of Inspection: 10/22/15________________________________
Name of Inspector(s): R. Howe, Paquette, J. Burke, V. Racaniello
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 2x/yr) ☐Heavy Rainfall ☐Reported Incident

**A. Inspection Checklist**

| | Component | Observed Condition: Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|---|
| **1.** | **Landfill Cap/Wetlands:** | | | | | | |
| | Vegetation (e.g. grass) | X | | | | Grass was just cut | X |
| | Soil (Cap/Cover/Fill) | X | | | | Fill in burrows | |
| | Other: ____________________ | | | | | | |
| **2.** | **Drainage Structures:** | | | | | | |
| | Standing Water | X | | | | No water | X |
| | Toe Drain | X | | | | | X |
| | Drainage Channels | | X | | | Veg in west channel | |
| | French Drains/Outfalls | X | | | | | X |
| | Subsurface Drainage | X | | | | | X |
| | Pipes/Outfalls | | | | X | | X |
| | Manholes | | | | X | | X |
| | Berms | | | | X | | X |
| | Roof Drains | X | | | | Significant vegetation | X |
| | Recharge Areas | | | | | | |
| | Other: ______________ | | | | | | |
| **3.** | **Monitoring System:** | | | | | | |
| | Soil Gas Wells | X | | | | | X |
| | Groundwater Wells | X | | | | | X |
| | Gas Vents | X | | | | No nests in vents | X |
| | Other: ______________ | X | | | | | X |
| **4.** | **Site Access:** | | | | | | |
| | Asphalt Access Road | | X | | | Repair pothole to east | |
| | Crushed-concrete Access Road | | X | | | | X |
| | Fence | | | | X | | X |
| | Gates/locks | | | | X | | X |
| | Radiological Postings | | | | X | | X |
| | Other: LUIC Signs | X | | | | All signs in place | X |

**5.** Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: ________________________________________

**B. Description of Other Observations**

Observed Conditions/Recommendations: Former Landfill, Interim Landfill, and Slit Trench caps are in good condition. Three burrows and shallow erosional areas observed on west slope of Former Landfill need to be filled-in by Facilities and Operations (F&O). The grass on all three landfills was cut within the last two weeks. F&O needs to remove small pine seedlings on west slope of Former Landfill, spray vegetation in western drainage channels, fill asphalt cracks, and repair pothole. Met with the Nonproliferation and National Security Department 10/14/15 to discuss potential upgrades to the Radiation Detector Test and Evaluation Center facility located adjacent to the Former Landfill. Any changes adjacent to the landfill will be discussed with the regulators first. LUIC Factsheet Changes: None.

Location (AOC): Former Hazardous Waste Management Facility Perimeter Soils
Date of Inspection: 10/19/15___________________________________
Name of Inspector(s): R. Howe, J. Burke, D. Paquette
Purpose of Inspection: ☒ Routine (Sched Freq of 2x/yr) ☐ Heavy Rainfall ☐ Reported Incident

**A. Inspection Checklist**

| | Component | Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|---|
| **1.** | **Soil Covers/Wetlands:** | | | | | | |
| | Vegetation (e.g. grass) | X | | | | | X |
| | Soil (Cap/Cover/Fill) | X | | | | | X |
| | Other: ____________________ | | | | | | |
| **2.** | **Drainage Structures:** | | | | | | |
| | Standing Water | X | | | | None | X |
| | Toe Drain | | | | X | | X |
| | Drainage Channels | | | | X | | X |
| | French Drains/Outfalls | | | | X | | X |
| | Subsurface Drainage | | | | X | | X |
| | Pipes/Outfalls | | | | X | | X |
| | Manholes | | | | X | | X |
| | Berms | | | | X | | X |
| | Roof Drains | | | | X | | X |
| | Recharge Areas | | | | X | | X |
| | Other: __ | | | | | | |
| **3.** | **Monitoring System:** | | | | | | |
| | Soil Gas Wells | | | | X | | X |
| | Groundwater Wells | | | | X | | X |
| | Gas Vents | | | | X | | X |
| | Other: ________________________ | | | | | | |
| **4.** | **Site Access:** | | | | | | |
| | Asphalt Access Road | | | | X | | X |
| | Crushed-concrete Access Road | | | | X | | X |
| | Fence | | | | X | | X |
| | Gates/locks | | | | X | | X |
| | Radiological Postings | | | | X | | X |
| | Other: | | | | | | |

**5.** Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: ______________________________________________

**B. Description of Other Observations**

Observed Conditions/Recommendations: The soil cover for the Phase 1 cleanup areas was in place and no erosion was evident. The Phase 3 cleanup was completed in the fall 2014. There was good vegetative growth in both areas. LUIC Factsheet Changes: Add links for the Phase III cleanup documents.

Location (AOC): Building 811 Former A/B Waste Transfer Lines______________________
Date of Inspection: 10/20/15____________________
Name of Inspector(s): R. Howe, J. Burke, V. Racaniello
Purpose of Inspection: ☒ Routine (Sched Freq of 2x/yr) ☐ Heavy Rainfall ☐ Reported Incident

**A. Inspection Checklist**

| | Component | Observed Condition: Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|---|
| **1.** | **Soil Covers/Wetlands:** | | | | | | |
| | Vegetation (e.g. grass) | X | | | | | X |
| | Soil (Cap/Cover/Fill) | X | | | | No erosion evident | X |
| | Other: ____________________ | | | | | | |
| **2.** | **Drainage Structures:** | | | | | | |
| | Standing Water | | | | X | | X |
| | Toe Drain | | | | X | | X |
| | Drainage Channels | | | | X | | X |
| | French Drains/Outfalls | | | | X | | X |
| | Subsurface Drainage | | | | X | | X |
| | Pipes/Outfalls | | | | X | | X |
| | Manholes | | | | X | | X |
| | Berms | | | | X | | X |
| | Roof Drains | | | | X | | X |
| | Recharge Areas | | | | | | |
| | Other: ______________________ | | | | | | |
| **3.** | **Monitoring System:** | | | | | | |
| | Soil Gas Wells | | | | X | | X |
| | Groundwater Wells | X | | | | | X |
| | Gas Vents | | | | X | | X |
| | Other: ______________________ | | | | | | |
| **4.** | **Site Access:** | | | | | | |
| | Asphalt Access Road | X | | | | | X |
| | Crushed-concrete Access Road | | | | X | | X |
| | Fence | | | | X | | X |
| | Gates/locks | | | | X | B 811 | X |
| | Radiological Postings | X | | | | B 811 | X |
| | Other: LUIC POC Signs | | | | X | | X |

**5.** Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No

**B. Description of Other Observations**

Observed Conditions/Recommendations: Good vegetation growth and no erosion evident. Area in front of Bldg. 811is temporarily fenced for the demolition work. LUIC Factsheet Changes: None.

Location (AOC): Old Incinerator Facility
Date of Inspection: 11/2/15
Name of Inspector(s): R. Howe, W. Dorsch, D. Paquette, M. Hanson
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 2x/yr) ☐ Heavy Rainfall ☐ Reported Incident

**A. Inspection Checklist**

| Component | Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|
| **1. Landfill Cap/Soil Covers:** | | | | | | |
| Vegetation (e.g. grass) | X | | | | | X |
| Soil (Cap/Cover/Fill) | X | | | | No erosion visible | X |
| Other: | | | | | | |
| **2. Drainage Structures:** | | | | | | |
| Standing Water | | | | X | | X |
| Toe Drain | | | | X | | X |
| Drainage Channels | | | | X | | X |
| French Drains/Outfalls | | | | X | | X |
| Subsurface Drainage | | | | X | | X |
| Pipes/Outfalls | | | | X | | X |
| Manholes | | | | X | | X |
| Berms | | | | X | | X |
| Roof Drains | | | | X | | X |
| Recharge Areas | | | | | | |
| Other: | | | | | | |
| **3. Monitoring System:** | | | | | | |
| Soil Gas Wells | | | | X | | X |
| Groundwater Wells | X | | | | | X |
| Gas Vents | | | | X | | X |
| Other: | | | | | | |
| **4. Site Access:** | | | | | | |
| Asphalt Access Road | | | | X | | X |
| Crushed-concrete Access Road | | | | X | | X |
| Fence | | | | X | | X |
| Gates/locks | | | | X | | X |
| Radiological Postings | | | | X | | X |
| Other: | | | | X | | X |

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence:

**B. Description of Other Observations**

Observed Conditions/Recommendations: Excellent vegetative growth, no erosion evident. LUIC Factsheet Changes: None.

Location (AOC): Low Mass Criticality Facility
Date of Inspection: 4/30/15______________________________
Name of Inspector(s): R. Howe, D. Paquette, K. Schwager
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

**A. Inspection Checklist**

| Component | Observed Condition: Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|
| **1. Soil Covers/Wetlands:** | | | | | | |
| Vegetation (e.g. grass) | | X | | | | X |
| Soil (Cap/Cover/Fill) | | | | X | | X |
| Other: ________________________ | | | | | | |
| **2. Drainage Structures:** | | | | | | |
| Standing Water | X | | | | Little water in basin | X |
| Toe Drain | | | | X | | X |
| Drainage Channels | | | | X | | X |
| French Drains/Outfalls | | | | X | | X |
| Subsurface Drainage | X | | | | | X |
| Pipes/Outfalls | X | | | | | X |
| Manholes | | | | X | | X |
| Berms | X | | | | | X |
| Roof Drains | | X | | | Phragmites in basin | X |
| Recharge Areas | | | | X | | X |
| Other: _______________ | | | | | | |
| **3. Monitoring System:** | | | | | | |
| Soil Gas Wells | | | | X | | X |
| Groundwater Wells | X | | | | | X |
| Gas Vents | | | | X | | X |
| Other: __________ | | | | X | | X |
| **4. Site Access:** | | | | | | |
| Asphalt Access Road | | | | X | | X |
| Crushed-concrete Access Road | | X | | | | X |
| Fence | | | | X | | X |
| Gates/locks | | | | X | | X |
| Radiological Postings | | | | X | | X |
| Other: ________________________ | | | | | | |

5. Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence:
____________________________________________________________

**B. Description of Other Observations**
Observed Conditions/Recommendations: No institutional control issues. LUIC Factsheet: No changes.

Location (AOC): AGS Storage Yards (1 and 2)
Date of Inspection: 4/30/15_____________________________________
Name of Inspector(s): R. Howe, F. Craner (EPD ECR), D. Paquette, K. Schwager, W. Needrith
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

**A. Inspection Checklist**

| | Component | Observed Condition: Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|---|
| **1.** | **Soil Covers/Wetlands:** | | | | | | |
| | Vegetation (e.g. grass) | | X | | | | X |
| | Soil (Cap/Cover/Fill) | | | | X | | X |
| | Other: ____________________ | | | | | | |
| **2.** | **Drainage Structures:** | | | | | | |
| | Standing Water | | | | X | | X |
| | Toe Drain | | | | X | | X |
| | Drainage Channels | | | | X | | X |
| | French Drains/Outfalls | | | | X | | X |
| | Subsurface Drainage | | | | X | | X |
| | Pipes/Outfalls | | | | X | | X |
| | Manholes | | | | X | | X |
| | Berms | | | | X | | X |
| | Roof Drains | | | | X | | X |
| | Recharge Areas | | | | X | | X |
| | Other: _______________ | | | | X | | X |
| **3.** | **Monitoring System:** | | | | | | |
| | Soil Gas Wells | | | | X | | X |
| | Groundwater Wells | | X | | | | X |
| | Gas Vents | | | | X | | X |
| | Other: __________ | | | | X | | X |
| **4.** | **Site Access:** | | | | | | |
| | Asphalt Access Road | | | | X | | X |
| | Crushed-concrete Access Road | | | | X | | X |
| | Fence | | X | | | No fence in Yard 2 | X |
| | Gates/locks | | X | | | No gate in Yard 2 | X |
| | Radiological Postings | | X | | | RMA postings good | X |
| | Other: ______________________ | | | | | | X |

**5.** Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: F. Craner (the ECR from EPD) and Bill Needrith representing CA-D attended the inspection and said there has been no unauthorized access to the posted/fenced rad storage areas. They are aware of the walkover survey that was done for B801/811 yard and that there is some contamination on the C-A D side of the fence. They moved some of the materials away from the fence due to the shine during the survey.

**B. Description of Other Observations**

Observed Conditions/Recommendations: The Bldg. 912 Steel Yard (Yard 1A) is a Radioactive Material Area (RMA). It is fenced, rad posted with a chain, and C-AD contact sign. The Bldg. 912 Steel/Lead Yard (Yard 1B), is also identified as a RMA, is rad posted, and secured with a fence, gate, lock, and C-AD contact sign. Yard 2 is a vacant field to the east of Bldg. 811 with no rad postings. Coordinate with F&O Grounds to have the street sweeper sand piles removed from Yard 2. The sand was removed last year but it is accumulating again.LUIC Factsheet Changes: None.

Location (AOC): Bubble Chamber
Date of Inspection: 4/30/15_____________________________________
Name of Inspector(s): R. Howe, F. Craner (EPD ECR), D. Paquette, K. Schwager, W. Needrith
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐ Heavy Rainfall ☐ Reported Incident

**A. Inspection Checklist**

| | Component | Observed Condition: Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|---|
| **1.** | **Soil Covers/Wetlands:** | | | | | | |
| | Vegetation (e.g. grass) | | X | | | | X |
| | Soil (Cap/Cover/Fill) | | | | X | | X |
| | Other: ____________________ | | | | | | |
| **2.** | **Drainage Structures:** | | | | | | |
| | Standing Water | X | | | | | X |
| | Toe Drain | | | | X | | X |
| | Drainage Channels | | | | X | | X |
| | French Drains/Outfalls | | | | X | | X |
| | Subsurface Drainage | | | | X | | X |
| | Pipes/Outfalls | | | | X | | X |
| | Manholes | | | | X | | X |
| | Berms | | | | X | | X |
| | Roof Drains | | | | X | | X |
| | Recharge Areas | | | | X | | X |
| | Other: _______________ | | | | | | |
| **3.** | **Monitoring System:** | | | | | | |
| | Soil Gas Wells | | | | X | | X |
| | Groundwater Wells | | X | | | | X |
| | Gas Vents | | | | X | | X |
| | Other: __________ | | | | X | | X |
| **4.** | **Site Access:** | | | | | | |
| | Asphalt Access Road | | X | | | | X |
| | Crushed-concrete Access Road | | | | X | | X |
| | Fence | X | | | | | X |
| | Gates/locks | X | | | | B960 gate locked | X |
| | Radiological Postings | X | | | | C-AD Rad Storage | X |
| | Other: ________________________ | | | | | | |

**5.** Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: Frank Craner (the ECR from EPD) and Bill Needrith representing C-AD attended the inspection and said there has been no unauthorized access to the posted/fenced rad storage area. In addition, any digging proposed for the area would be reviewed by the Groundwater Protection Group via the digging permit process. Frank did mention that C-AD may be moving their hazardous waste storage from Bldg. 919 to adjacent to the yard at Bldg. 960, but it's not definite.

**B. Description of Other Observations**

Observed Conditions/Recommendations: The fenced area is controlled by Collider-Accelerator Dept. (C-AD) and is designated as the Bldg. 960 Waste Yard. It is used for outdoor storage of rad materials. It is fenced, locked, with rad postings, and paved. The remainder of the area to the north is open and consists of grass, pavement, and concrete slabs (no postings). LUIC Factsheet Changes: No changes.

Location (AOC): Bldg. 830 USTs and Pipe Leak
Date of Inspection: 4/30/15____________________________________
Name of Inspector(s): R. Howe, D. Paquette, K. Schwager
Purpose of Inspection: ☒ Routine (Scheduled Freq. of 1x/yr) ☐Heavy Rainfall ☐Reported Incident

**A. Inspection Checklist**

| Component | Excell. | Fair | Poor | Not Applic. | Further Action Req'd: Yes (describe) | No |
|---|---|---|---|---|---|---|
| **1. Soil Covers/Wetlands:** | | | | | | |
| Vegetation (e.g. grass) | | | | X | | X |
| Soil (Cap/Cover/Fill) | | | | X | | X |
| Other: ___________________ | | | | | | |
| **2. Drainage Structures:** | | | | | | |
| Standing Water | | | | X | | X |
| Toe Drain | | | | X | | X |
| Drainage Channels | | | | X | | X |
| French Drains/Outfalls | | | | X | | X |
| Subsurface Drainage | | | | X | | X |
| Pipes/Outfalls | | | | X | | X |
| Manholes | | | | X | | X |
| Berms | | | | X | | X |
| Roof Drains | | | | X | | X |
| Recharge Areas | | | | X | | X |
| Other: _______________ | | | | X | | X |
| **3. Monitoring System:** | | | | | | |
| Soil Gas Wells | | | | X | | X |
| Groundwater Wells | | X | | | | X |
| Gas Vents | | | | X | | X |
| Other: __________ | | | | X | | X |
| **4. Site Access:** | | | | | | |
| Asphalt Access Road | X | | | | | X |
| Crushed-concrete Access Road | | | | X | | X |
| Fence | | | | X | | X |
| Gates/locks | | | | X | | X |
| Radiological Postings | X | | | | For Rad Storage Area | X |
| Other: ________________________ | | | | | | |

**5.** Evidence of unauthorized work activities and/or unauthorized access has occurred? ☐ Yes ☒ No
If yes, describe evidence: Digging proposed for the area would be reviewed by the Groundwater Protection Group via the digging permit process.

**B. Description of Other Observations**

Observed Conditions/Recommendations: The area currently consists of Bldg. 830 (occupied) by the Nonproliferation and National Security Department within the Global and Regional Solutions Directorate. The NSLS II Project Offices are located in the mod trailer to the north. Outdoor connex storage, waste collection area, and rad waste storage areas are present. LUIC Factsheet Changes: No changes.

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/7/15 |
|---|
| **A. System OU III** LIPA/Airport. Inspection attendees include V. Racaniello, R. Howe, A. Steinhauff, E. Kramer, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: Construction is complete, system operating. Airport wells RTW-2, RTW-3, and RTW-5 are pulse pumping, and LIPA wells EW-1L, EW-2L, and EW-3L are in standby. |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒Good condition ☐ All required wells properly operating ☒ Needs Maintenance<br>Remarks: LIPA extraction well EW-4L is not operating due to the loss of wireless communication with the Airport treatment building. This is due to repairs being performed on the BNL meterological tower which holds the communications antenna. The work should be completed in July 2015. |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks________________________________________________ |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks________________________________________________ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☐ Air stripping ☒ Carbon adsorbers<br>☐ Filters________________________________________<br>☐ Additive (*e.g.*, chelation agent, flocculent):<br>☐ Others________________________________________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually________________<br>☐ Quantity of surface water treated annually________________<br>Remarks_ ________________________________________________ |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☒ Needs Maintenance<br>Remarks: The guard rails on the LIPA well vault needs to be repaired. |

| | |
|---|---|
| 4. | **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☒ Needs Maintenance<br>Remarks: Injection and recirculation wells require routine maintenance to prevent clogging. Flow meters on two Airport injection wells need to be replaced.<br>________________________________________________________________________ |
| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: _______________________________________________________ |
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☒ Needs Maintenance ☐ N/A<br>Remarks_Monitoring wells 000-104 and 000-105, adjacent to the LIPA well vault were missing the outer bolts and the inside of the wells weren't locked. Repairs will be made.<br>________________________________________________________________________ |
| **D. Monitoring Data** | |
| 1. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 2. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: VOC concentrations in LIPA EWs EW-1L, EW-2L, and EW-3L have remained low over the last several years. VOCs in EW-4L has been steadily dropping. VOCs in Airport EWs have been low and stable, while VOCs in RW-6A are slightly higher. |

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/7/15 |
|---|
| **A. System OU III** North Street/North Street East. Inspection attendees include V. Racaniello, A. Steinhauff, R. Howe, E. Kramer, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: Construction is complete, both systems operating. NSE system was shut down and placed in stand-by mode in June 2014. NS EWs were shut off June 2015 and placed in standby mode. |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: Well NS-1 and NSE-1 are pulse pumping. Well NSE-2 is in standby.<br>___ |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks___<br>___ |
| 3. **Spare Parts and Equipment**<br>☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks___<br>___ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☐ Air stripping ☒ Carbon adsorbers<br>☐ Filters___<br>☐ Additive (*e.g.*, chelation agent, flocculent):<br>☐ Others___<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually___<br>☐ Quantity of surface water treated annually___<br>Remarks___<br>___ |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance<br>Remarks___<br>___ |
| 4. **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Injection wells need routine maintenance due to fouling (every 6 to 12 months). |

| | |
|---|---|
| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☒ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: Weeds growing in the gutters need to be removed.<br>______________________________________________<br>______________________________________________ |
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks______________________________________________<br>______________________________________________ |
| **D. Monitoring Data** | |
| 3. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 4. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining |

| |
|---|
| **VIII. GROUNDWATER REMEDIES** ☒ Applicable ☐ N/A 7/7/15 |
| **A. System** OU VI AOC 28 EDB. Inspection attendees include V. Racaniello, A. Steinhauff, R. Howe, E. Kramer, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☐ Air stripping ☒ Carbon adsorbers<br>☐ Filters<br>☐ Additive (*e.g.*, chelation agent, flocculent):<br>☐ Others<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually<br>☐ Quantity of surface water treated annually<br>Remarks |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance<br>Remarks |
| 4. **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: |

| | |
|---|---|
| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☒ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: One of the air conditioners and the front door stop need repair. |
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks_Monitoring well 000-520 is missing outer bolts, but it is located within the locked fence by the building.________________________________________________ |
| **D. Monitoring Data** | |
| 5. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 6. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining<br>Remarks: The plume is progressing to the extraction wells slower than originally projected. |

**VIII. GROUNDWATER REMEDIES** ☒ Applicable ☐ N/A 7/7/15

**A. System** OU III Deep VOCs in Industrial Park. Inspection attendees include V. Racaniello, A. Steinhauff, R. Howe, E. Kramer, M. Chuc, K. Schwager

1. **Construction Complete/System Operating** ☒ Yes ☐ No

Remarks: The Industrial Park East system was approved for closure in 2013, and the extraction wells and several monitoring wells were abandoned. Starting in late 2014, the building and associated utilities, the carbon units, and injection wells are being used to treat the deep VOC plume in the Industrial Park.

**B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks:

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks______________________________

3. **Spare Parts and Equipment**
☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks______________________________

**C. Treatment System** ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☒ Carbon adsorbers
☐ Filters______________________________
☐ Additive (*e.g.*, chelation agent, flocculent):
☐ Others______________________________
☒ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☒ Quantity of groundwater treated annually______________
☐ Quantity of surface water treated annually______________
Remarks______________________________

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks:

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
Remarks______________________________

4. **Discharge Structure and Appurtenances**
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks: The injection wells require periodic maintenance

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| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: |
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks: |
| **D. Monitoring Data** | |
| 7. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 8. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining<br>Remarks: The VOCs in the Upper Glacial/Magothy aquifer interface are moving slower than projected toward the extraction wells. |

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/7/15 |
|---|
| **A. System** OU III Industrial Park. Inspection attendees include V. Racaniello, A. Steinhauff, R. Howe, E. Kramer, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: The system is currently in stand-by mode. |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☐ All required wells properly operating ☒ Needs Maintenance ☐ N/A<br>Remarks: Treatment wells UVB-1, UVB-2 and UVB-7 are shutdown due to low VOC concentrations in these wells. Wells UVB-3, UVB-4, UVB-5 and UVB-6 are off pending maintenance to install float switched in the extraction well vaults. Update: The switches were installed and these wells were restarted 7/9/15. |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks_______________ |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks_______________ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☒ Air stripping ☒ Carbon adsorbers (vapor phase)<br>☐ Filters_______________<br>☐ Additive (*e.g.*, chelation agent, flocculent):<br>☐ Others_______________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually_______________<br>☐ Quantity of surface water treated annually_______________<br>Remarks_______________ |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance<br>Remarks_______________ |

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| 4. | **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: These wells are recirculation wells with two screens and require frequent cleaning to keep them operational |
| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: ________________ |
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks________________________________________________________________________________<br>________________________________________________________________________________ |
| **D. Monitoring Data** | |
| 9. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 10. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: System was approved for shutdown in 2013 but wells UVB-3, UVB-4, UVB-5, UVB-6 were restarted due to rebounding VOCs. |

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| **VIII. GROUNDWATER REMEDIES** ☒ Applicable ☐ N/A 7/14/15 | |
| **A. System OU III AOC 29** HFBR Tritium Pump and Recharge. Inspection attendees include V. Racaniello, E. Kramer, A. Steinhauff, R. Howe, M. Chuc, K. Schwager | |
| 1. | **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: The system is currently in standby mode. |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A | |
| 1. | **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: The four extraction wells are in standby mode. |
| 2. | **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks |
| 3. | **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks |
| **C. Treatment System** ☒ Applicable ☐ N/A | |
| 1. | **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☐ Air stripping ☒ Carbon adsorbers<br>☐ Filters________________<br>☐ Additive (*e.g.*, chelation agent, flocculent):<br>☐ Others________________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually________________<br>☐ Quantity of surface water treated annually________________<br>Remarks: The carbon was removed from the vessels in Sept. 2014 and not replaced. |
| 2. | **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: |
| 3. | **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance<br>Remarks________________ |
| 4. | **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: |
| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: The inside of Bldg. 598 needs housekeeping. |

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| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks |
| **D. Monitoring Data** | |
| 11. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 12. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: Approval was received from the regulators on the Petition for Shutdown since the system met its cleanup goals. The system was shut down and placed in stand-by mode in May 2013. |

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/14/15 |
|---|
| **A. System** OU I South Boundary (Bldg. 598 and 645) Inspection attendees include V. Racaniello, , E. Kramer, A. Steinhauff, R. Howe, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: The system is currently in standby mode. |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: Both extraction wells are in standby mode. |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks______________________________________________ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☒ Air stripping ☐ Carbon adsorbers<br>☐ Filters______________________________________________<br>☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________<br>☐ Others______________________________________________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☐ Quantity of groundwater treated annually________________________<br>☐ Quantity of surface water treated annually________________________<br>Remarks______________________________________________<br>______________________________________________ |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☒ Needs Maintenance<br>Remarks_Repairs are being made on the electrical system and controllers that were damaged due to lightning strike in early July.<br>______________________________________________<br>______________________________________________ |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance |
| 4. **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Recharge Basin is in good condition. |

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| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☒ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: The inside of Bldg. 598 needs housekeeping. In June, graffiti was found on two of the outside walls and door of Bldg. 645 (near the LIE). A police report was filed. The graffiti will be removed. |
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks |
| **D. Monitoring Data** | |
| 13. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 14. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: Approval was received from the regulators on the Petition for Shutdown since the system met its cleanup goals. The system was shut down and placed in stand-by mode in July 2013. |

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/14/15 |
|---|
| **A. System** OU III South Boundary (Bldg.517 and Bldg 518) Inspection attendees include V. Racaniello, E. Kramer, A. Steinhauff, R. Howe, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: Wells EW-6,7,8 and 12 are in standby due to low VOC concentrations. |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: Wells EW-3,4,5 and 17 are operating. |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks________________________________________ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☒ Air stripping ☐ Carbon adsorbers<br>☐ Filters________________________________________<br>☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________<br>☐ Others________________________________________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually________________________<br>☐ Quantity of surface water treated annually________________________<br>Remarks________________________________________<br>________________________________________ |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks________________________________________<br>________________________________________ |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance |
| 4. **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Recharge Basins are in excellent condition but require occasional maintenance |
| 5. **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: |

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| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks |
| **D. Monitoring Data** | |
| 15. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 16. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining<br>Remarks: Four of the eight extraction wells are currently operating. The four eastern wells have met the cleanup goals. A new extraction well, EW-17 was installed and became operational in 2012 to address the deeper VOC contamination between EW-3 and EW-4. |

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/14/15 |
|---|
| **A. System** OU III Middle Road (Bldg.516 and 519) Inspection attendees include V. Racaniello, , E. Kramer, A. Steinhauff, R. Howe, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: The three eastern extraction wells RW-4, RW-5 and RW-6 are in standby and have met the Remedial Action Objectives for this project. |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☐ Good condition ☒ All required wells properly operating ☒ Needs Maintenance ☐ N/A<br>Remarks: RW-1, 3, and 7 are operating. In May, well RW-2 was found with water coming out of the above ground pitless adapter. This was due to a hole in the well screen. The well was shut down and a new screen is currently being installed. This was reported as a treatment system bypass in the May SPDES Equivalency Permit Discharge Monitoring Report. |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks_______________________________________________________________ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☒ Air stripping ☐ Carbon adsorbers<br>☐ Filters_______________________________________________________________<br>☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________<br>☐ Others_______________________________________________________________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually________________________<br>☐ Quantity of surface water treated annually________________________<br>Remarks_______________________________________________________________<br>_______________________________________________________________________ |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks_______________________________________________________________<br>_______________________________________________________________________ |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance |

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| 4. | **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Recharge Basins are is in good condition. |
| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: |
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks |
| **D. Monitoring Data** | |
| 17. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 18. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining<br>Remarks: The three eastern extraction wells have met cleanup goals and are in standby. A new extraction well, RW-7 was installed and became operational in 2013 to address the deeper VOC contamination in the western portion of the plume. |

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/14/15 |
|---|
| **A. System** OU III Western South Boundary (Bldg. 539) Inspection attendees include V. Racaniello, E. Kramer, A. Steinhauff, R. Howe, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: Both wells are currently operating. |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: Well WSB-2 is being pulsed pumped, one month on and two months off. |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks______________________________________________________________ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☒ Air stripping ☐ Carbon adsorbers<br>☐ Filters__________________________________________________________________<br>☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used________<br>☐ Others__________________________________________________________________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually________________________<br>☐ Quantity of surface water treated annually________________________<br>Remarks_The O&M Manual is missing from the building. A replacement will be provided.____<br>__________________________________________________________________________ |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks__________________________________________________________________<br>__________________________________________________________________________ |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance |
| 4. **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Recharge Basin is in good condition |
| 5. **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: |

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| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks | |
| **D. Monitoring Data** | | |
| 19. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality | |
| 20. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: | |

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/14/15 |
|---|
| A. System OU III Building 96 (Bldg. TR-854, TR-866, TR-867, TR_868) Inspection attendees include V. Racaniello, , E. Kramer, A. Steinhauff, R. Howe, M. Chuc, K. Schwager |
| 1. Construction Complete/System Operating ☒ Yes ☐ No<br>Remarks: Well RTW-4 is on standby mode due to low VOCs. . |
| B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A |
| 1. Pumps, Wellhead Plumbing, and Electrical<br>☐ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: RTW-1, 2, and 3 are operating. |
| 2. Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances<br>☒ Good condition ☐ Needs Maintenance<br>Remarks |
| 3. Spare Parts and Equipment<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks________________________________________________________________ |
| C. Treatment System ☒ Applicable ☐ N/A |
| 1. Treatment Train (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☒ Air stripping ☐ Carbon adsorbers<br>☒ Filters The air inlet port screens on the side of the buildings need to be cleaned of debris._______<br>☐ Additive (*e.g.*, chelation agent, flocculent)________<br>☐ Others__________________________________________________________________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually________________________<br>☐ Quantity of surface water treated annually________________________<br>Remarks: Well RTW-1, 2, and 3 are also capturing and treating low levels of Freon-11 from the Bldg. 452 plume. |
| 2. Electrical Enclosures and Panels (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks__________________________________________________________________<br>__________________________________________________________________________ |
| 3. Tanks, Vaults, Storage Vessels<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance |
| 4. Discharge Structure and Appurtenances<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Recharge Basin is in excellent condition |
| 5. Treatment Building(s)<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☒ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: |

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| 6. | Monitoring Wells (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks |
| D. Monitoring Data | |
| 21. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 22. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: As of the third quarter of 2015, hexavalent chromium is no longer sampled for in the monitoring wells. A soil vapor survey on the western portion of the plume will be performed. |

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| **VIII. GROUNDWATER REMEDIES** ☒ Applicable ☐ N/A 7/14/15 | |
| **A. System** OU III Freon-11 (Bldg. 644) Inspection attendees include V. Racaniello, E. Kramer, A. Steinhauff, R. Howe, M. Chuc, K. Schwager | |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: The system began pulse pumping (one month on and one month off) in February 2015. | |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A | |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: | |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks | |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks___ | |
| **C. Treatment System** ☒ Applicable ☐ N/A | |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☒ Air stripping ☐ Carbon adsorbers<br>☐ Filters_ The air inlet port screens on the side of the building needs to be cleaned of debris.___<br>☐ Additive (*e.g.*, chelation agent, flocculent)_sodium polyphosphate is not used___<br>☐ Others___<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually___<br>☐ Quantity of surface water treated annually___<br>Remarks: | |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks___ | |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance | |
| 4. **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Recharge Basin is in good condition | |
| 5. **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☒ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: | |
| 6. **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks | |
| **D. Monitoring Data** | |
| 23. Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality | |
| 24. Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: Freon-11 concentrations have significantly declined to below the capture goal. A Petition for Shutdown will be prepared in 2015 for submittal to the regulators. | |

| VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A 7/14/15 |
|---|
| **A. System** OU III Sr-90 Chemical Holes (Bldg. 670) Inspection attendees include V. Racaniello, E. Kramer, A. Steinhauff, R. Howe, M. Chuc, K. Schwager |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: System is currently off in pulsed pumping mode (one month on and two months off). |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks: |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks: A minor water leak at one of the tank vessel fittings needs to be repaired.__________<br>______________________________________________________________________ |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks______________________________________________________________<br>______________________________________________________________________ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☐ Air stripping ☐ Carbon adsorbers<br>☒ Filters: ion exchange__________________________________<br>☐ Additive (*e.g.*, chelation agent, flocculent)_________________________________<br>☐ Others__________________________________________________________<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually________________________<br>☐ Quantity of surface water treated annually________________________<br>Remarks: |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks______________________________________________________________<br>______________________________________________________________________ |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance<br>Remarks: Six, 210 gal. tanks used to store purge water are registered by SCDHS.______ |
| 4. **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Drywells have never required maintenance. |
| 5. **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks: |

| | |
|---|---|
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks________________________________ |
| **D. Monitoring Data** | |
| 25. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 26. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: Concentrations in all extraction wells have significantly declined. However, elevated Sr-90 persists upgradient of EW-1. Soil sampling in the vadose zone is planned for this area. |

| **VIII. GROUNDWATER REMEDIES** ☒ Applicable ☐ N/A 7/15/15 |
|---|
| **A. System OU III** Sr-90 BGRR/WCF (Bldg. 855) Inspection attendees include R. Howe |
| 1. **Construction Complete/System Operating** ☒ Yes ☐ No<br>Remarks: All wells operational |
| **B. Groundwater Extraction Wells, Pumps, and Pipelines** ☒ Applicable ☐ N/A |
| 1. **Pumps, Wellhead Plumbing, and Electrical**<br>☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A<br>Remarks_Wells SR-4, 5 and 6 are being pulsed pumped (one month on and one month off).<br>___ |
| 2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>☒ Good condition ☐ Needs Maintenance<br>Remarks: ___ |
| 3. **Spare Parts and Equipment**<br>☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided<br>Remarks___<br>___ |
| **C. Treatment System** ☒ Applicable ☐ N/A |
| 1. **Treatment Train** (Check components that apply)<br>☐ Metals removal ☐ Oil/water separation ☐ Bioremediation<br>☐ Air stripping ☒ Carbon adsorbers<br>☒ Filters: ion exchange ___<br>☐ Additive (*e.g.*, chelation agent, flocculent)___<br>☐ Others___<br>☒ Good condition ☐ Needs Maintenance<br>☒ Sampling ports properly marked and functional<br>☒ Sampling/maintenance log displayed and up to date<br>☒ Equipment properly identified<br>☒ Quantity of groundwater treated annually___<br>☐ Quantity of surface water treated annually___<br>Remarks: |
| 2. **Electrical Enclosures and Panels** (properly rated and functional)<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks___<br>___ |
| 3. **Tanks, Vaults, Storage Vessels**<br>☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance<br>Remarks___<br>___ |
| 4. **Discharge Structure and Appurtenances**<br>☐ N/A ☒ Good condition ☐ Needs Maintenance<br>Remarks: Drywells were cleaned in 2014 due to clogging. |

| | |
|---|---|
| 5. | **Treatment Building(s)**<br>☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair<br>☐ Chemicals and equipment properly stored<br>Remarks________________________________________ |
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition<br>☐ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks________________________________________ |
| **D. Monitoring Data** | |
| 27. | Monitoring Data<br>☒ Is routinely submitted on time ☒ Is of acceptable quality |
| 28. | Monitoring data suggests:<br>☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining<br>Remarks: Removal of Bldg. 811 and associated contaminated soil at the Waste Concentration Facility area is underway in July 2015. |

| E. Monitored Natural Attenuation |
|---|
| 1. **Monitoring Wells** (natural attenuation remedy)<br>☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition<br>☒ All required wells located ☐ Needs Maintenance ☐ N/A<br>Remarks: A portion of each groundwater remedy relies on some natural attenuation.________________ |
| **IX. OTHER REMEDIES** |
| If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. |
| **X. OVERALL OBSERVATIONS** |
| **A. Implementation of the Remedy** |
| Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).<br><br>With the exception of the HFBR stack and reactor vessel removal, all soil, sediment, and groundwater remedies for the nine RODs at the site have been implemented and are functioned as designed. This includes the excavation and off-site disposal of contaminated soils, sediments, tanks, as well as the installation and operations initiated for all groundwater treatment systems. All of the remedies are being implemented in accordance with the RODs and the ESDs. The remedies are expected to be protective upon attainment of soil cleanup goals once excavation is complete, and groundwater cleanup goals.<br>______________________________________________ |
| **B. Adequacy of O&M** |
| Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.<br><br>The VOC treatment systems operated without any significant down time or issues over the last five years and have consistently met the state equivalency discharge requirements (although there have been a few pH excursions due to the natural groundwater conditions). Typically, the systems have been physically inspected two times per week since 2011. All of the treatment systems are also monitored remotely via the wireless monitoring/alarms system. System O&M has been very effective .<br>______________________________________________________________ |
| **C. Early Indicators of Potential Remedy Problems** |
| Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.<br><br>• See Five Year Review Section 7.0. ________________________________________________ |
| **D. Opportunities for Optimization** |
| Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Opportunities are routinely identified. See Five Year Review Section 7.0_____________<br>__________________________________________________________________________ |

# Attachment 4

# Interview Records

# INTERVIEW RECORD

| | |
|---|---|
| **Site Name:** Brookhaven National Laboratory | **EPA ID No.:** |
| **Subject:** 2016 Five-Year Review | **Time:** 2 pm **Date:** 9/29/15 |
| **Type:** X Telephone ☐ Visit ☐ Other<br>**Location of Visit:** | ☐ Incoming ☐ Outgoing |

**Contact Made By:**

| | | |
|---|---|---|
| **Name:** S. Johnson | **Title:** | **Organization:** BNL Stakeholder Relations |

**Individual Contacted:**

| | | |
|---|---|---|
| **Name:** Jessica Mollin | **Title:** Remedial Project Manager | **Organization:** EPA II |

| | |
|---|---|
| **Telephone No.:** 212-637-3921<br>**Fax No.:**<br>**E-Mail Address:** mollin.jessica@epa.gov | **Street Address: 290 Broadway**<br>**City, State, Zip:** New York, NY 10007-1866 |

## Summary of Conversation

Ms. Mollin stated that her overall impression of the cleanup at BNL is actually very good. She said everyone is incredibly organized and the effort of communication is good.

Regarding specific aspects of the cleanup to focus on during the review she said that the Peconic River should be a focus based on what is going on currently.

She does believe that the remedies are functioning as expected by the RODs. She is not aware of any upcoming changes to any federal laws or regulations for Brookhaven.

Ms. Mollin's initial feeling is that there aren't any big risks that would get in the way of achieving the soil and groundwater cleanup objectives but she wanted to take some time to reflect on the question and may provide additional comments in the next few days.

She feels that BNL and DOE are "absolutely" actively managing the long-term cleanup operations and are properly maintaining appropriate institutional controls.

She did not have any comments or suggestions or recommendations; she said that it is a pleasure to work with BNL and they should show everyone else how to do it.

# INTERVIEW RECORD

| | | | |
|---|---|---|---|
| **Site Name:** Brookhaven National Laboratory | | | **EPA ID No.:** |
| **Subject:** 2016 Five-Year Review | | | **Time:** 3:10 pm **Date:** 9/29/15 |
| **Type:** X Telephone ☐ Visit ☐ Other<br>**Location of Visit:** | | | ☐ Incoming ☐ Outgoing |
| **Contact Made By:** | | | |
| **Name:** S. Johnson | **Title:** | | **Organization:** BNL Stakeholder Relations |
| **Individual Contacted:** | | | |
| **Name:** Mindy Pensak | **Title:** Ecological Risk Assessor | | **Organization:** EPA |
| **Telephone No.:** 732-321-6705<br>**Fax No.:**<br>**E-Mail Address:** pensak.mindy@epa.gov | | **Street Address:** 2890 Woodbridge Avenue<br>**City, State, Zip:** Edison, NJ 08837 | |

## Summary of Conversation

Ms. Pensak has only been participating on the IAG calls since November 2014.

She felt that determining what is going to be done with the Peconic River should be a focus of the Review. She isn't sure what the purpose is of continuing to sample to get to the cleanup goal; is this the way to reach the ROD goal? It isn't clear to her what the number was based on, and questions what it will mean if we don't get to that number. She feels the number (goal) needs to be re-evaluated.

She was not aware of any upcoming changes to federal laws or regulations in regard to sediment.

Her thoughts were that if the goal was re-evaluated there might not be a need for continually sampling.

# INTERVIEW RECORD

| | | |
|---|---|---|
| **Site Name:** Brookhaven National Laboratory | | **EPA ID No.:** |
| **Subject:** 2016 Five-Year Review | | **Time:** 10 am **Date:** 9/29/15 |
| **Type:** X Telephone ☐ Visit ☐ Other<br>**Location of Visit:** | | ☐ Incoming ☐ Outgoing |
| **Contact Made By:** | | |
| **Name:** S. Johnson | **Title:** | **Organization:** BNL Stakeholder Relations |
| **Individual Contacted:** | | |
| **Name:** Brian Jankauskas | **Title:** Project Manager | **Organization:** NYSDEC |
| **Telephone No.:** 518-402-9626<br>**Fax No.:**<br>**E-Mail Address:**<br>brian.jankauskas@dec.ny.gov | **Street Address:** 625 Broadway, 11th Floor<br>**City, State, Zip:** Albany, NY 12233 | |

## Summary of Conversation

- *What is your overall impression of the cleanup at BNL?*

  BNL's actions have made significant progress in cleaning up the environment and BNL continues to remediate known areas of contamination as well as new areas of contamination that are identified.

- *Are there any specific aspects of the cleanup that you feel should be of particular focus during the review?*

  The contamination detected in the Peconic River warrants further evaluation. BNL is currently defining the extents of contamination within a portion of the river. BNL may want to review historical documents to try and understand why this contamination is present since a remedial action and subsequent action were conducted within this portion of the river.

- *Do you feel well informed about BNL's cleanup activities and progress?*

  Yes.

- *Do you believe the public is sufficiently informed of the cleanup progress?*

  Yes.

- *Do you believe the remedies are functioning as expected by the RODs?*

  Sediment contamination within a portion of the Peconic River has been detected above the cleanup goals for the ROD. This is presently being evaluated to determine the appropriate action. Remedies for the other portions of the site are functioning as expected by the RODs.

- *Are you aware of any particular component of the cleanup decisions that pose a higher degree of difficulty in achieving?*

  The sediment goals for a portion of the Peconic River were not achieved following the remedial action and subsequent action. This may be due to the complexity of working within a river.

- *Are you aware of any recent or upcoming changes to federal or New York State laws, regulations, or cleanup standards that may impact protectiveness of human health and the environment at BNL?*

  No.

- *Do you believe there are current opportunities to optimize operations and maintenance, or sampling efforts at BNL that could result in cost savings or improved efficiency?*

  No.

- *What do you think are the biggest risks to achieving the soil and groundwater cleanup objectives at BNL?*

  The sensitive environments of the Peconic River need to be assessed when trying to determine the next step and obtaining the cleanup objectives. The groundwater cleanup objectives appear to be attainable, but unknown contamination outside the capture zones may be identified in the future.

# INTERVIEW RECORD

| | |
|---|---|
| **Site Name:** Brookhaven National Laboratory | **EPA ID No.:** |
| **Subject:** 2016 Five-Year Review | **Time:** 2:33pm **Date:** 9/28/15 |
| **Type:** X Telephone ☐ Visit ☐ Other<br>**Location of Visit:** | ☐ Incoming ☐ Outgoing |

**Contact Made By:**

| | | |
|---|---|---|
| **Name:** S. Johnson | **Title:** | **Organization:** Stakeholder Relations |

**Individual Contacted:**

| | | |
|---|---|---|
| **Name:** Steve Karpinski | **Title:** Public Health Specialist, Bureau of Environmental Exposure Investigation | **Organization:** NYSDOH |

| | |
|---|---|
| **Telephone No.:** 518-402-7860<br>**Fax No.:**<br>**E-Mail Address:**<br>steven.karpinski@health.ny.gov | **Street Address:** Empire Plaza, Corning Tower, Room 1787<br>**City, State, Zip:** Albany, NY 12237 |

## Summary of Conversation

Mr. Karpinski stated that he is very impressed and extremely happy with the way things are going with the cleanup at BNL. This is one of the easiest sites to deal with. Everything that he would expect to have addressed has been. It has been an interesting and rewarding experience to be involved with the IAG for the past seven years.

He said nothing of particular focus nor any specific aspects of the cleanup jump out at him. The additional time spent on the Peconic River is the closest thing that he can see that could be any kind of public health issue but that's not expected because of the location.

Mr. Karpinski stated that he believes the remedies are functioning as expected by the RODs. The only changes to federal or state regulations that he is aware of were to the Soil Vapor Guidance document, which aren't tremendous changes, and changes to the air guideline action levels for TCE and PCE, however, they're not issues at BNL.

With regard to the biggest risk to achieving the soil and groundwater cleanup objectives Mr. Karpinski said that just the pure technical aspect of knowing where the groundwater contamination is and isn't and making the necessary changes to get ahead of the contamination.

Yes, Mr. Karpinski feels that BNL and DOE are actively managing the long-term cleanup operations for the site and are properly maintaining appropriate institutional controls. He had no comments or suggestions; the work that is put in to maintain the programs is impressive compared to other sites that he is involved with.

# INTERVIEW RECORD

| | |
|---|---|
| **Site Name:** Brookhaven National Laboratory | **EPA ID No.:** |
| **Subject:** 2016 Five-Year Review | **Time:** 9:09 am **Date:** 10/7 |
| **Type:** X Telephone ☐ Visit ☐ Other<br>**Location of Visit:** | ☐ Incoming ☐ Outgoing |

| | | |
|---|---|---|
| **Contact Made By:** | | |
| **Name:** S. Johnson | **Title:** | **Organization:** BNL Stakeholder Relations |

| | | |
|---|---|---|
| **Individual Contacted:** | | |
| **Name:** David O'Hehir | **Title:** Associate Radiological Health Specialist | **Organization:** NYSDOH |

| | |
|---|---|
| **Telephone No.:** 518-402-7550<br>**Fax No.:**<br>**E-Mail Address:** david.ohehir@health.ny.gov | **Street Address:** Empire Plaza, Corning Tower<br>**City, State, Zip:** Albany, NY 12237 |

## Summary of Conversation

Mr. O'Hehir's overall impression of the cleanup is that it is going well, moving forward. DOE and the contractor are being responsive to his concerns and comments.

The specific aspect of the cleanup that Mr. O'Hehir thinks should be focused on is the one item that hasn't been remediated yet, which is the stack. Remediation was tried with ARRA funding but wasn't successful. He's wondering what the path forward and plan is to get it done in a timely manner (by 2020).

Mr. O'Hehir said that he believes the remedies are functioning as expected with the caveat that there have been some issues. He said both DOE and the contractor have addressed the minor issues as is expected. He is not aware of any component of the cleanup that poses difficulty in achieving, nor is he aware of any recent or upcoming changes to state laws, from the radiological perspective.

Mr. O'Hehir felt that the biggest risk to achieving cleanup right now is the unknown source terms for groundwater which are being investigated by DOE and the contractor. He does feel that BNL and DOE are actively managing the long-term cleanup operations and are properly maintaining appropriate institutional controls. He had no additional comments, suggestions, or recommendations.

# INTERVIEW RECORD

| | | |
|---|---|---|
| **Site Name:** Brookhaven National Laboratory | | **EPA ID No.:** |
| **Subject:** 2016 Five-Year Review | | **Time:** 9:15 am **Date:** 10/7 |
| **Type:** X Telephone ☐ Visit ☐ Other<br>**Location of Visit:** | | ☐ Incoming ☐ Outgoing |
| **Contact Made By:** | | |
| **Name:** S. Johnson | **Title:** | **Organization:** BNL Stakeholder Relations |
| **Individual Contacted:** | | |
| **Name:** Andrew Rapiejko | **Title:** Associate Hydrogeologist | **Organization:** SCDHS |
| **Telephone No.:** 631-852-5786<br>**Fax No.:**<br>**E-Mail Address:**<br>Andrew.rapiekjo@suffolkcountyny.gov | **Street Address:** 360 Yaphank Ave., Ste. 3B<br>**City, State, Zip:** Yaphank, NY 11980 | |

## Summary of Conversation

Mr. Rapiejko's overall impression of the cleanup is that the Lab has done a good job, it has been successful. He thinks that the specific aspect of the cleanup that should be focused on is the Peconic River and the elevated mercury concentrations. He feels well informed about the cleanup activities and progress and from his perspective thinks that the public is sufficiently informed, at least as much as he can gage.

Mr. Rapiejko believes that the remedies are functioning as expected and he would say there is not any component of the cleanup that poses a higher degree of difficulty in achieving.

He thinks the biggest risk to achieving the groundwater cleanup objectives are any unknowns, anything that wasn't accounted for, although there was diligence in the initial characterization so any unknowns should be minimal. He feels that BNL and DOE are actively managing the long-term cleanup operations and properly maintaining appropriate institutional controls.

Mr. Rapiejko commented that he feels it is important to have the funding and staff to continue the monitoring and assessing of the cleanup activities.

# INTERVIEW RECORD

| | |
|---|---|
| **Site Name:** Brookhaven National Laboratory | **EPA ID No.:** |
| **Subject:** 2016 Five-Year Review | **Time:** 10:30 **Date:** 10/5 |
| **Type:** X Telephone ☐ Visit ☐ Other<br>**Location of Visit:** | ☐ Incoming ☐ Outgoing |

**Contact Made By:**

| | | |
|---|---|---|
| **Name:** S. Johnson | **Title:** | **Organization:** BNL Stakeholder Relations |

**Individual Contacted:**

| | | |
|---|---|---|
| **Name:** Terri Kneitel | **Title**: Environmental Engineer | **Organization:** DOE |

| | |
|---|---|
| **Telephone No.:** 631-344-2112<br>**Fax No.:**<br>**E-Mail Address:** tkneitel@bnl.gov | **Street Address:** Bell Avenue<br>**City, State, Zip:** Upton, NY |

## Summary of Conversation

Ms. Kneitel's overall impression of the cleanup is that it was done well and done professionally. The specific aspects of the cleanup that she thought should be focused on were the emerging issues of the Peconic River sediment and Strontium-90.

She believes that the public is sufficiently informed about the cleanup and said that BNL does a lot of outreach. She also believes that the remedies are functioning as expected by the RODs.

Regarding the components of the cleanup that may pose a higher degree of difficulty to achieve, she noted that the lack of an exit strategy for monitoring in the Peconic River makes cleanup difficult to achieve.

She does not believe there are current opportunities to optimize operations and maintenance that could result in cost savings because BNL is doing this all the time and does a good job.

Ms. Kneitel thinks BNL is on track to achieve soil and groundwater cleanup objectives. She said the biggest risk would be discovery of a continuing source of Sr-90.

Ms. Kneitel had no comments, suggestions, or recommendations regarding management of the cleanup. She said they are doing a good job.

# Attachment 5

# Technology and Standards Review Memos
# (T. Sullivan to W. Dorsch, dated 10/1/15)

Building XXX
P.O. Box 5000
Upton, NY 11973-5000
Phone 631 344-2840
Fax 631 344-4486
TSullivan@bnl.gov

BROOKHAVEN NATIONAL LABORATORY

managed by Brookhaven Science Associates
for the U.S. Department of Energy

# Memo

*date:* *October 1, 2015*

*to:* *Bill Dorsch*

*from:* *Terry Sullivan*

***subject:*** *Strontium-90 (Sr-90) Five Year Review*

## 1) Introduction

As part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Environmental Protection Agency (EPA) requires a review of Brookhaven National Laboratory's (BNL) environmental remediation efforts on a five year cycle. BNL has four Sr-90 plumes on site, a) Building 650 plume; b) Brookhaven Graphite Research Reactor (BGRR) and Waste Concentration Facility (WCF) plume; c) Chemical Holes plume, and d) Former Hazardous Waste Management Facility (HWMF). The Building 650 plume and the Former HWMF plumes are small with low concentrations and are being addressed through Monitored Natural Attenuation (MNA). The other two plumes require an active pump and treat system. Initial modeling of the two actively treated plumes suggested that it would require 25 years of active remediation followed by monitoring. The systems have been operating for ten years and the plumes are more persistent than initial modeling suggested. Both plumes require continued active treatment to reach cleanup goals. For this reason, a review of Sr-90 treatment technologies at other sites was conducted to examine if viable options exist to remediate the plume in a shorter time frame without large cost implications. The evaluation criteria are:

- Advancements in cleanup technologies
- Changes in standards and regulations for worker, public, and environmental protection
- Environmental impacts
- Public health impacts
- Economic impacts

If this technical review identifies a remediation method that demonstrates the potential to be implemented that shows substantial improvements to the above criteria, analysis of that potential method will be initiated and possibly implemented.

## 2) Review of Sr-90 Plumes and Treatment systems

There are two strontium-90 (Sr-90) groundwater contamination plumes associated with Operable Unit III (OU III) that are undergoing active treatment on the BNL site. The first plume is the result of historical leakage from the Brookhaven Graphite Research Reactor (BGRR) and the Waste Concentration Facility (WCF). The second plume originates from the former "Chemical Holes" disposal site, which is the source of the contamination. There are two additional on-site Sr-90 plumes that are being monitored. One is originating from the Building 650 outfall the other is from the former Hazardous Waste Management Facility. The movement of these plumes is conservatively modeled based on existing data to demonstrate that Sr-90 concentrations will not exceed the drinking water standard of 8 pCi/L off-site. If new monitoring data indicate that this may not be true additional monitoring and, if warranted, active treatment will occur.

## *2.1 BGRR/WCF Plume*

Decommissioning of the BGRR began in 1997 with the discovery and subsequent removal of approximately 60,000 gallons of contaminated water that had infiltrated and accumulated in the below ground ducts. Groundwater characterization data after that detected Sr-90 with concentrations above the drinking water standard of 8 pCi/L. A second Sr-90 plume originating from the Waste Concentration Facility and near the BGRR plume was also discovered. The spatial proximity of these plumes allowed them to be treated together.

The 1999 OU III Remedial Investigation and Feasibility Study (RI/FS) considered several remedial alternatives to address this contamination. "Pump and treat" using ion exchange technology was the remedy selected in the OU III ROD. The OU III ROD relies on active "pump and treat" and continued monitoring to reach drinking water standards in 30 years. The selected remedy for the BGRR/WCF plumes relied on two extraction wells operating at high flow rates. This high flow rates caused withdrawal of water that was not originally contaminated resulting but still needed to be treated due to the mixing with the Sr-90 contaminated waters. This generated large amounts of contaminated resins that require disposal as low-level radioactive wastes. The original estimated cost to reach the cleanup goals was 6.5 million dollars. Operating experience and additional characterization indicated that the cost was more likely to be in excess of 55 million dollars (DOE, 2005).

The large operating and maintenance costs prompted DOE to submit an Explanation of Significant Differences (ESD) to the ROD. Several alternatives were evaluated to determine a more efficient method to be protective of the environment. The preferred alternative increased the number of extraction wells from two to five and ran the extraction wells at lower flow rates to reduce the volume of low-level waste. The use of additional wells allowed a more targeted removal action that captured essentially the same amount of radioactivity as the existing high flow wells. The revised approach suggested a ten year active treatment period based on the assumption that there was not a continuing source followed by monitoring until 2076 when the drinking water standards would be met. The estimated cost of this activity was $14 million. In 2005 the regulators agreed with the proposed approach and the ESD was accepted to allow this change. The ESD to the ROD also increased the time to reach drinking water standards from 30 to 70 years.

Waste Concentration Facility

The Waste Concentration Facility (WCF) had operated as a facility for processing and concentrating liquid radioactive wastes received from the Brookhaven Graphite Research

Reactor (BGRR), the Hot Laboratory Complex (Building 801), and the High Flux Beam Reactor (HFBR). Liquid wastes were stored in three 100,000 gallon above-ground storage tanks (known as D Tanks) from 1947 to 1987. Past operations and practices, including three documented leaks from the above-ground tanks, created both surface and deep soil contamination that required remediation. Subsequent characterization found additional leak pathways and contamination beneath the tanks. In 1995, the removal of the three above ground storage tanks was completed. In 2001, the removal of wastes from the six underground storage tanks was completed. Contaminated soil has also been removed from this area.

BGRR/WCF Treatment System
The BGRR/WCF treatment system currently consists of 9 extraction wells and 91 monitoring wells. Two extraction wells SR-1 and SR-2 are located just downgradient of the WCF. Three wells SR-3, SR-4, and SR-5 are located immediately downgradient of the BGRR. The remaining wells were installed in 2010 to capture the WCF plume that has migrated to the vicinity of the High Flux Beam Reactor (HFBR).

Monitoring of the WCF has shown that the concentrations in the source area have shown a significant decline from 2000 to 2010, with a slower decline after that. The highest concentrations still exceed 100 pCi/L in the source area and confirm that a residual source remains in this region. The extraction wells SR-1 and SR-2 appear to be successful in stopping the plume from migrating further south.

However, there is a second part of the plume that was beyond the reach of the extraction wells SR-1 and SR-2. Additional extraction wells were added in 2010 to capture this part of the plume which is near the HFBR. The peak monthly concentration in these wells was always less than 20 pCi/L and often less than 8 pCi/L in the monthly sampling performed in 2015. However, characterization data in temporary wells suggest that Sr-90 continues to be a groundwater issue in this area with many samples above the 8 pCi/L drinking water standards.

The BGRR plume is being treated by three extraction wells operating in pulsed mode. Monitoring data suggests that they are effectively capturing the plume. However, as with the WCF, a portion of the plume had migrated out of the capture zone of these wells prior to their installation. This part of the plume is being monitored and concentrations above the drinking water standard are expected to be contained on site.

## 2.2 Chemical Holes

The Chemical Holes were located in the south-central portion of the BNL property. The area contained 55 pits that were located east of the former landfill. These pits were filled with chemical waste from laboratory activities. The chemical holes were excavated for off-site disposal in 1997. Excavation went to the bottom of the pits, but not the top of the water table. This left a small contaminated zone between the water table and the bottom of the pits. Strontium-90 in these areas has been detected above the drinking water standard to levels up to 178 pCi/L (well 106-95) in 2015.

A treatment system comprised of three extraction wells has been developed. The extracted water is treated through ion-exchange. The first well was installed in 2003. The second and third wells, which are further from the source zone, were installed in 2007. The three wells are located along the centerline of the plume at different distances from the source area. The average flow rate in these wells was 14 gpm in 2013. Extraction well concentrations are less than 20 pCi/L in 2013 and have been steadily decreasing. A total of slightly less than 5 mCi of Sr has been removed by the extraction system between 2003 and 2015.

The initial modeling for the ESD to the ROD suggested that it would require about 10 years of active treatment followed by 30 years of monitoring to meet the drinking water standard of 8 pCi/L. However, this has not proven to be the case. The modeling was based on no continuing source of Sr-90 to the aquifer. Concentrations around 100 pCi/L persist in 2015 at the top of the water table near the Chemical Holes suggesting that a continuing source exists. Further evidence that a source remains come from wells 106-94, 106-95, and 106-99. These are the three closest wells in the centerline of the plume with 106-94 being the closest to the source area. All three wells have remained far above the drinking water standard and have had slowly decreasing concentrations over the past 10 years.

Additional characterization data collected in 2013 using temporary wells also showed concentrations around 100 pCi/L at the top of the water table. The area of high concentration is localized as the temporary wells were spaced approximately 20 feet apart and wells adjacent to the high concentration wells showed concentrations of 2 or 3 pCi/L. This small area of contamination suggests that a targeted action may be effective to reduce the source in the vadose zone.

A recent modeling study (P.W. Grosser, 2015) predicted that it would take much more than 25 years for the current plume to have the concentrations fall below 8 pCi/L if the existing treatment system were turned off. This model assumes that there is no further release to the aquifer, which appears to contradict the data, suggesting a longer time may be needed. This is clearly not a viable alternative and the pump and treat system will need to continue operations.

## 2.3 Building 650 Plume

The Reclamation Facility (Building 650) was used to decontaminate radiologically contaminated clothing and equipment. Liquid effluent was discharged through a pipe to an outfall area approximately 1200 feet to the west of the building. Soils near this facility and the sump-outfall area have become contaminated from these activities. Initially, several radionuclides exceeded the soil cleanup goals. In 2002, the contaminated soil, piping, and decontamination pad was removed. However, a plume of Sr-90 can be traced to the sump outfall area.

Sr-90 groundwater concentrations in the source area near the sump outfall continue to decrease indicating that the source is being depleted. Higher concentrations (up to 130 pCi/L in 2014) have been observed downstream. This is not unanticipated as higher concentrations have been observed in the past. The leading edge of the plume is near Brookhaven Avenue. Modeling performed in 2010 suggests that the 8 pCi/L drinking water standard will be met by 2034 and that the leading edge of the plume will be 250 feet south of Brookhaven Avenue and contained on the BNL site. The current plan for management of this plume is continued monitoring to make sure that the model predictions are valid.

## 2.4 Former Hazardous Waste Management Plume

The Former Hazardous Waste Management Facility (HWMF) was the site's central RCRA and radioactive waste receiving facility for storing wastes prior to off-site disposal until 1997. Several spills were documented at the former HWMF. A soil remediation program was completed in 2005 to reduce the contamination levels. The VOC plume from this site has been treated, however, there remain residual amounts of Sr-90 that are routinely detected in groundwater above the drinking water standard of 8 pCi/L. A sentinel well, well 108-45 located 700 feet from the site boundary, has shown an increase in Sr-90 from 1 pCi/L to around 5 pCi/L in 2015. The well nearest the source of contamination in the Former HWMF, well 88-26, hovered around 10 pCi/L from 2005 until 2012. After that time, it has decreased to less than 5 pCi/L. However, well 98-30, which is between the well 88-26 and the sentinel well has shown a steady increase in concentration over recent years rising from 8 pCi/L in 2009 to 35 pCi/L in 2015. This suggests that there is a slug of Sr-90 moving through the system.

The increase in Sr-90 concentration in the two wells downstream of the Former HWMF raised concerns and a series of geoprobe wells were installed to further define the plume. Geoprobe samples were collected at four foot intervals to define the vertical location of the plume. Sampling performed at the upstream edge of the Former HWMF showed slight Sr-90 contamination levels (< 8 pCi/L). A row of geoprobe wells spaced approximately 50 feet apart and 300 feet downgradient of the Former HWMF found Sr-90 contamination in five adjacent wells above 8 pCi/L with a maximum concentration of 217 pCi/L (OUI-SR90-GP-40). Most of the contamination was between 8 and 32 pCi/L, however, two wells had Sr-90 levels above 100 pCi/L. The highest concentration occurred at the last sampling location and the transect is being extended to define the plume. An additional row of geoprobe wells is planned approximately 700 feet further south (downgradient) near well 98-30. This will define the width and depth of the plume at this location.

## 3.0 Review of Advances in Strontium Treatment Technology

The major change in strontium treatment technology is to move away from pump-and-treat systems due to their high costs and limited effectiveness towards permeable reactive barriers. This approach has been used at three DOE sites: Hanford, Savannah River, and West Valley. Table 1 summarizes the treatment system, hydrogeologic system, and contaminant concentrations a these three sites. A more detailed discussion of each site follows.

**Table 1 Summary of Sr-90 subsurface barrier treatment systems.**

| | Hanford | Savannah River | West Valley |
|---|---|---|---|
| Plume Description | 0.4 square mile area, 10 to 37 m deep. | 2.4 square mile area, 10 to 20 m deep. | 430 m long, 200 m wide, 9 m deep. |
| Plume Origin | Liquid Waste disposal in trenches during the 1950's through 1980's. | Acid Waste disposal in ponds during the 1950's through 1980's. | Facility operations spills and leaks between 1966 and 1972. |
| Hydrogeology | Vadose Zone: 0 - 23 meters thick. Unconfined Aquifer 6.5 – 14 m thick. Confining aquitard beneath the unconfined aquifer. | Clay layer 20 meters below grade. | Confining till (clay) layer six to nine meters deep. |
| Remedy | Permeable Reactive Barrier with Apatite | Funnel and Gate Barrier with Base addition to | Permeable Reactive Barrier with Zeolite |

| | | | |
|---|---|---|---|
| | | raise pH. | (Clinoptilite). |
| Barrier Depth | Water table to a depth of 14 meters. | Water table to a depth of 20 meters. | Surface to a depth of 9 meters |
| Maximum concentrations | 15,000 pCi/L (2012) | 3200 pCi/L (early 1990's) 213 pCi/L in 2013. | 400,000 pCi/L 100,000 pCi/L in 2014. |
| Concentration after treatment | 70 – 210 pCi/L (2012). | Near MCLs (< 80 in treatment zone). | Not available. |
| Comments | Pump and treat only reduced peak values by a factor of 2 (e.g. > 8000 pCi/L). Apatite PRB reduces concentrations by a factor of 6 to 20. Concerns remain about the length of cleanup. | Base addition works to immobilize Sr in the treatment zone. However, concerns over how long the base additions will be needed still exist. | The site has not addressed long-term cleanup issues. They will review and develop a plan by 2030 after evaluating the effectiveness of the PRB. |

### *3.1) Hanford*

The US DOE Hanford site contains several strontium-90 plumes with contamination above the 8 pCi/L drinking water standard. The biggest concern is in the N area adjacent to the Columbia River where peak concentrations are greater than 10,000 pCi/L. The high concentrations of strontium-90 in groundwater near the river required an expedited response action in 1995. A pump-and-treat system was designed and installed to create a hydraulic barrier between the river and the liquid waste disposal facility, such that the rate of strontium-90 movement into the river is reduced. An evaluation of the performance of this system is conducted annually. The remedial action continues to reduce the hydraulic gradient toward the river, reducing the net flux to the river by greater than 90%. However, based on the groundwater monitoring network in 2009, the size, and shape of the strontium-90 plume in groundwater have varied little over the years, Figure 1. The plume has nearly the same areal extent and shape currently as was evidenced in 1996 (prior to startup of 100-N Area pump-and-treat operations.

Strontium-90 is present in the vadose zone beneath the two disposal facilities, having been adsorbed onto sediments. As the water level decreases, strontium‐ 90 remains in the vadose zone above the water table. When the water table rises strontium‐ 90 from the periodically re-wetted vadose zone is mobilized and the concentrations in groundwater increase. This creates considerable variability in concentrations observed at some monitoring wells. Levels have been consistent for the last few years, with the increase and decrease of strontium‐ 90 concentrations mirroring changes in the water table elevation.

While the system removed strontium from the groundwater, the strontium in the soil re-contaminates the groundwater again and again. Based on soil characteristics (strontium distribution coefficient is 15 $cm^3/g$) it was estimated that less than 1% was in solution with the remainder sorbed to the soil. Thus, to flush the system would take 100's of years. The pump-and-treat removal of 1.8 Ci from 1995 to 2006 was very small compared to the total quantity of Sr-90 discharged to the liquid waste disposal facility, which was estimated to be 1,866 Ci. The amount of Sr-90 discharged to the river in this 11 year period was 1.5 – 2.1 Ci, roughly the same as the amount removed. It was estimated that significantly more Sr-90 decayed in place (~ 400 Ci) during the operational period than was removed. This high energy requirements and operational and maintenance costs required for very little return on investment led the Hanford site to place the system in standby in 2006. In addition to pump-and-treat efforts, DOE tried to insert an underground metal barrier along the shoreline to intercept strontium migration to the river. Hanford scientists also studied the idea of freezing the aquifer and flushing the soil. These efforts did not succeed.

The continued high-level of Sr-90 near the river led to the development of another approach to remediation. In 2008 a permeable reactive barrier (PRB) using Apatite-forming minerals was created by injection into 10 wells along the Columbia River shoreline to create a 90-meter (300-foot) long barrier. Apatite minerals sequester elements into their molecular structures via substitution, whereby elements of similar physical and chemical characteristics replace calcium, phosphate, or hydroxide in the hexagonal crystal structure. Sr-90 replaces calcium and becomes immobilized. The data from this work indicates that apatite sequestration is effective for immobilizing Sr-90 in situ. In 2010 the Record of Decision (ROD) was amended and the selected remedy became the apatite PRB. The PRB was extended to a length of approximately 760 m (2,500 ft.), immediately adjacent and parallel to the Columbia River. This will provide increased protection of the Columbia River by immobilizing, and therefore, removing Sr-90 from the groundwater before it enters the river.

Prior to treatment with Apatite, two baselines for strontium concentration were developed to represent the annual variability. The upper baseline represents the typical maximum values observed and the lower baseline represents the typical lower annual values. Post-treatment aqueous $^{90}Sr$ concentrations, based on both direct measurements of $^{90}Sr$ and $^{90}Sr$ equivalents (i.e., scaled gross beta particle emissions) have been collected at compliance locations along the river. Short-term increases in the $^{90}Sr$ concentration at these compliance well locations, which

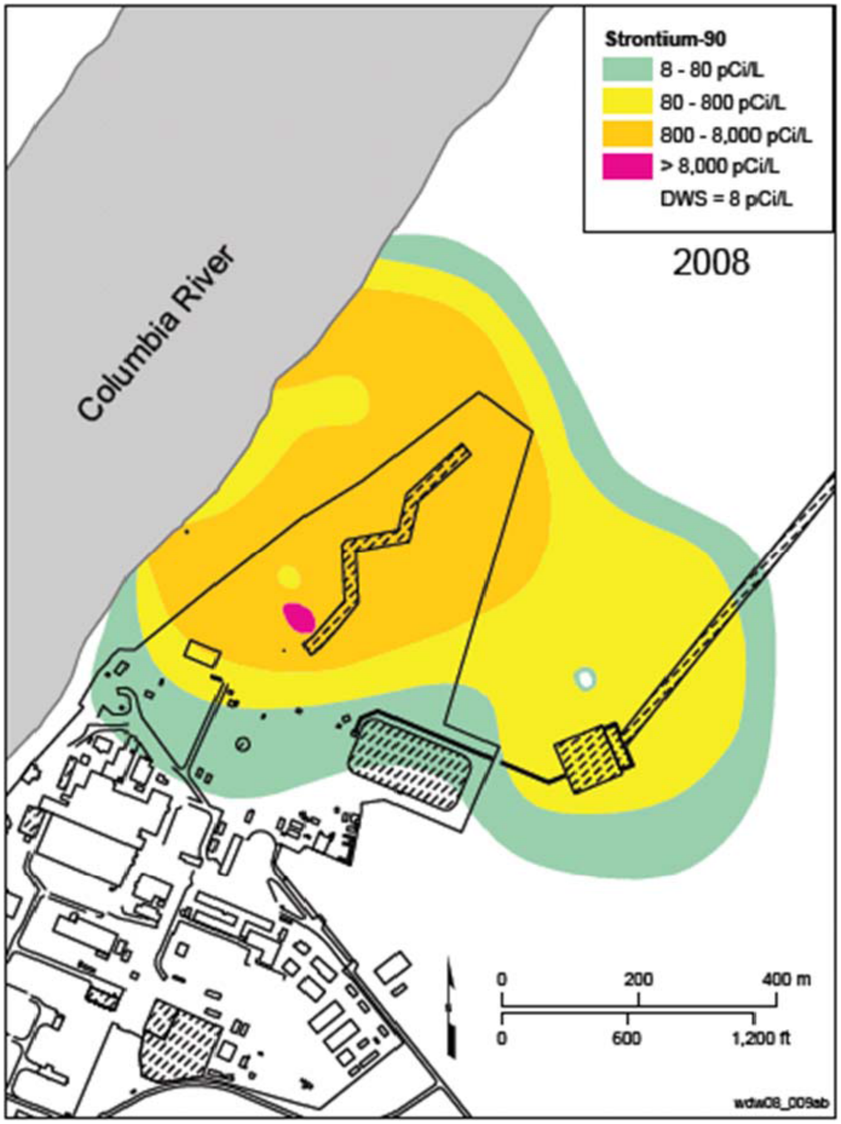


**Figure 1 Strontium plume at the Hanford site along the Columbia River in 2008.**

are associated with the injection of high-ionic strength apatite amendment solutions during treatment, generally fell near or below the baseline maximum concentration. One well hade short term increases in $^{90}$Sr concentration that reached approximately five times the baseline maximum value. Also worth noting is the elevated $^{90}$Sr concentration observed in September 2011 at compliance monitoring well. This increase was associated with amendment injections in adjacent wells that were performed in support of PRB expansion activities. Longer-term monitoring results continue to show seasonal variability, with concentrations decreasing during periods of high Columbia River stage when groundwater flows are reversed (i.e., bank storage is occurring) and increasing when river stage drops and groundwater with mobilized $^{90}$Sr is migrating toward the discharge boundary at elevated groundwater velocities (September/October time frame). Although this seasonal trend is still present in the post treatment data, observed post treatment $^{90}$Sr concentrations fall near or below the baseline. The average reduction in $^{90}$Sr concentrations at the four compliance monitoring locations was a factor of 20 relative to the high end of the baseline range and a factor of 6 relative to the low end of the baseline range approximately 1 year after treatment. By the 4th year after treatment, these performance metrics had decreased slightly.

Monitoring well concentrations downstream of the barrier had Sr-90 concentrations between 70 and 200 pCi/L. This is due to incomplete coverage of the apatite zones and water table fluctuations. Given the amount of Sr in the vadose zone there is concern that it will take more than 100 years to meet cleanup goals. In 2014, the Hanford Advisory Board HAB) recommended targeted source removal from the vadose zone, use of apatite in the vadose zone above the existing barrier to reduce the effects of groundwater fluctuation, and mini PRBs in the aquifer near known sources (HAB, 2014). While the HAB, Regulators, and DOE all believe that the PRB is an improvement over pump-and-treat, it has not completely solved Hanford's strontium problems.

### *3.2) Savannah River*

The US DOE site at Savannah River operated unlined F and H Area Seepage Basins from 1955 until 1988 for the disposition of deionized acidic waste water from the F and H Separations Facilities. Additionally, fuel failures, primarily in the 1950's and 1960's led to direct release of tens of curies of Sr-90 directly to the on-site streams (Carlton, 1992). Waste water from nuclear plant operations contained low concentrations of non-radioactive metals, and radionuclides, with the major isotopes being Cs-137, Sr-90, U-235, U-238, Pu-239, Tc-99, I-129, and tritium. The tritium concentration in the waste water was elevated with concentrations in excess of 10,000,000 pCi/L. The acid content of the waste water during the operational period of the basins was equal to 12 billion liters of nitric acid. The seepage basins were closed in 1988 and backfilled and capped by 1991. The high acidic content of these seepage basins mobilized many nuclides leading to a mixed plume. Groundwater discharges of Sr-90 to the Fourmile Branch were consistently around 3200 pCi/L in the early 1990's (Carlton, 1992).

The plumes associated with the F and H basins cover an area of nearly 2.4 square kilometers (600 acres) and discharge along ~2,600 meters of Fourmile Branch. The acidic nature of the plumes and their overall discharge extent along the branch represent a large challenge with respect to reducing contaminant flux to Fourmile Branch. The introduction of nitric acid into the groundwater over a long time effectively reduced the pH of the aquifer and consequently reduced the retardation of metal migration from the basins to the groundwater and in the groundwater to Fourmile Branch. The pH was low enough (< 4) that most negatively charged surfaces on the aquifer materials were filled with hydrogen ion and unavailable for the metal ions.

Two large pump and treat systems were constructed in 1997 and operated until 2003 in an attempt to capture and control the releases to Fourmile Branch. These systems included flocculation tanks, reverse osmosis, and resin beds to remove the metals and contaminants in the groundwater. The operating cost, including waste disposal, for the two systems was ~$1.3M/month. Both systems employed reinjection of tritiated water up gradient of the extraction, and produced large quantities of waste from non-tritium isotopes and metals removal prior to reinjection. Both systems were determined to be ineffective and potentially detrimental with respect to limiting the flux of contaminants to Fourmile Branch.

After it became apparent that there was very little benefit to continued operation of the systems, and the staggering cost of operations was recognized by the SRS and regulators, a new remedy was developed in 2005. The new system uses vertical subsurface barriers to redirect groundwater flow to limit the transport of contaminants to the stream. The barriers were constructed of acid resistant grout using deep soil mixing techniques. The grout mixture used low swelling clay, fly ash, and sodium hydroxide to form a pozzolan material with low permeability and low strength. The SRS and regulators agreed to a series of remedial goals, with the first goal to reduce tritium flux to the stream by 70% and bring constituents other than tritium to groundwater protection standards.

At the F Area Seepage Basins the subsurface barriers extend to 18 meters (60 feet) below the surface, and form a funnel and gate system 1,036 meters (3,400 feet) long. The system contains three gates that have openings set in the upper portion of the water table, which promotes water movement mostly in the top of the stratigraphic section. The gates also contain a base injection system to neutralize nitric acid, raise the pH and cause the precipitation of metals onto aquifer materials. Injection of the alkaline solution establishes treatment zones for uranium and Sr-90 for approximately 30 meters down gradient of the gates. The base neutralizes the acidity of the plume and aquifer mineral surfaces causing sorption of the contaminants and possible precipitation of uranium silicates. For each injection campaign between 5.7 and 13.2 million liters (1.5 to 3.5 million gallons) of alkaline solution are injected per gate. An injection campaign takes about two months to complete. Since 2005, 132 million liters (35 million gallons) have been injected at all three gates. The gate areas comprise about 306 linear meters of the funnel and-gate system.

Treatment at the gates has been effective at reducing aqueous concentrations of most metal and metallic radionuclide contaminants. Due to the large volume of alkaline solution, the effect of diluting the contaminants rather than neutralization was a concern. The effect of dilution was determined using tritium because it is a non-reactive contaminant. The effect of dilution corresponded to a contaminant reduction factor of 1.5. For Sr-90 the reduction in concentration is a factor of 5 from upstream values. Thus, the concentrations are still above the drinking water standard of 8 pCi/L.

At the H Area Seepage Basins the subsurface barriers extend to 27 meters (90 feet) below the surface and have a cumulative length of 1,005 meters (3,300 feet). The barriers are positioned up gradient (length of 610 meters (2,000 feet)) and down gradient (length of 400 meters (1,300 feet)) of the largest seepage basin (H-4). The barriers create a “step-down” configuration from up gradient of the basins to down gradient of the basins adjacent to Fourmile Branch, with a large reduction in groundwater gradient within each of the steps. The reduction in gradient is used to reduce the flux of contaminants to the stream. The peak Sr-90 concentration in this area was 425 pCi/L in 2013.

Construction of the subsurface barriers was completed in 2005; a 70% reduction in tritium flux was achieved by 2011. SRS has implemented several base injection campaigns in the gates and down gradient of the barriers to work toward achieving standards in Fourmile Branch for all constituents other than tritium. It is believed that achieving groundwater protection standards for radioactive metals including Sr-90 will be achieved soon. SRS is currently evaluating a passive reactive treatment for I-129 in one of the gates at the F Area Seepage Basins.

### *3.3) West Valley*

Reprocessing of nuclear fuel occurred at the West Valley site from 1966 to 1972 but was closed down following regulatory reform of the nuclear industry that drove the costs higher than expected. Contamination came from piping leaks within the former irradiated (used) nuclear fuel reprocessing plant during operation. Contaminated liquid moved through expansion joints in the floor of the plant and into the underlying soil. Sampling beneath the plant confirmed the presence of Sr-90 and other isotopes consistent with the documented leaks. Although releases have stopped since the West Valley Facility ceased operations in 1972, a continuing source of Sr-90 from the vadose zone has kept concentrations well above the drinking water standard to this day.

The Department of Energy is responsible for environmental remediation of the site and they set up the West Valley Demonstration Project (WVDP) to address remediation goals. Sr-90 is more mobile in groundwater than the other isotopes involved at West Valley and has been carried with groundwater passing beneath the plant. Strontium concentrations in excess of 400,000 pCi/L have been measured on site. The groundwater moves above a confining layer of glacial clay (till) which varies throughout the deposit from approximately 1.2-9.1 meter (4-30 feet) below the surface. The Sr-90 plume extends primarily northeast from the plant moving downgradient toward the edge of the WVDP site and the edge of the small plateau upon which the facility was built. At or near the edge of the plateau, the groundwater comes to the surface as springs or seeps.

The plume is approximately 430 meters (1,400 feet) long at levels above 10,000 pCi/L. It extends from the reprocessing plant downgradient approximately 275 meters (900 feet), the groundwater follows a fairly narrow path 120 -152 m (400-500 feet) in width. Beyond approximately 275 meters (900 feet) the plume widens to approximately 213 meters (700 feet) and three distinct preferential pathways (lobes) occur.

A pump-and-treat system was installed in 1995 and was still operating in 2013. The system has treated 54.7 million gallons of water and removed 9 curies of Sr-90 by 2010. However, the recovery system does not completely prevent migration of the plume. WVDP is considering the permanent shut down of this system.

In 1999, a 9 meter (30 feet) permeable treatment wall (PTW) was installed as a pilot program. The PTW used one pass trenching to remove existing soil and install clinoptolite. The wall was capable of removing Sr-90 but a number of problems arose during the installation including a decrease in permeability relative to the native soils that led to less flow through the wall than predicted. It was concluded that the wall, while effective, was too small to control the migration of strontium.

Installation of a second PTW, approximately 259 meters (860 feet) long was completed in the fall of 2010. The excavation was approximately 1 meter (39 inches) wide and from 5.8-9.1 meters (19- 30 feet) deep and 2,600 metric tons of zeolite were installed using a one-pass trencher. The excavated soil was placed directly into an aboveground containment structure via a conveyor specifically designed and fabricated for use in this project.

The PTW is intended to contain further expansion of the leading edge of the Sr-90 plume until a long-term management approach is selected for this area of the WVDP site. Planning for the PTW focused on designing and installing a system that could function for up to 20 years. Current agencies' plans call for making a decision on the long-term management of the plume by 2020.

The full-scale PTW, installed in November 2010, has now been monitored for three years. Performance monitoring data collected to date indicate:

- groundwater flow patterns in the PTW area are similar to those observed prior to PTW construction indicating that the PTW installation did not significantly alter groundwater flow conditions on the north plateau;
- strontium-90 activity in groundwater immediately downgradient of the PTW has decreased; and
- strontium-90 activity that had already migrated past the PTW prior to its installation is continuing to migrate downgradient. However, downgradient strontium-90 concentrations are expected to decrease over time as groundwater treated by the PTW flows towards these areas.

Based on the January 2013 and January 2014 annual sampling results, there are no longer strontium-90 concentrations greater than 10,000 pCi/L in the downgradient (e.g. past the PTW) western or central lobes and no detected strontium-90 activities above 1,000 pCi/L in the downgradient eastern lobe of the strontium-90 plume. The PTW has decreased the concentration of the contaminant strontium-90 in the groundwater by 77 percent since the wall began operating in late 2010.

## *3.4) Discussion*

There are several important points to observe from the experiences of these three major Sr-90 contamination sites:

a) All three sites found the standard pump-and-treat option ineffective and moved to some type of permeable barrier system that would allow for decay in place. The permeable barrier systems have a major cost advantage in that there is no water removal and therefore, no need for treatment. All three sites had an underlying layer that they could key into which is not the case at BNL.
b) The sorption of the strontium onto the soil provides a continual source that is difficult to remove quickly. This is evidenced by the fact that the plumes have existed for more than 20 years without a discernable reduction in size and only a slight reduction in concentration due to radioactive decay.
c) The West Valley and Hanford sites have contamination in the vadose zone that acts as a continuing source. The plume at the Hanford site is responsive to variations in the water table with increases in the groundwater concentration after the water table rises and decreases when the water table falls. This implies that effective source control would require removing all of the contaminated soil above the water table to stop the continual replenishment of the strontium to the groundwater.
d) The permeable reactive barrier systems are relatively new (< 5 years) and long-term performance is not guaranteed. The Hanford Advisory Board is suggesting additional treatment zones for the apatite to improve performance. The PRB's at these sites have required multi-million dollar up-front investments for installation.

## 4) Review of criteria for changing the current strategy.

### *Advancements in cleanup technologies*

Several DOE sites with active treatment of Strontium-90 plumes have moved away from active pump and treat to passive treatment with permeable barriers. This approach has led to a factor of ten or more decrease in strontium concentrations after the groundwater has passed through the barrier. The long term effectiveness of these barriers is not known. While this approach has been successful at all three sites, it is not applicable at BNL. All sites have a near surface layer to key into. This allows flow to be funneled through the barrier wall. At BNL the clay layer is far below the land surface thus it would be cost prohibitive and may not be feasible from an engineering standpoint. A targeted soil amendment to sequester the Sr-90, such as apatite used at Hanford, is unproven and would likely lead to slight decreases in permeability that would cause flow to be diverted around the treatment zone.

### *Changes in standards and regulations for worker, public, and environmental protection*

There has not been a change in the standards for worker, public or environmental protection in the last five years. Although these may change in the future, there is no current activity to change existing limits and regulations.

### *Environmental impacts*

The Sr-90 levels are currently above the drinking water standards. However, the monitoring data collected over the past ten years suggests that the existing pump and treat system will capture the plume. This indicates that further action is not necessary if BNL wishes to continue operating the system for the necessary time to deplete the existing source in the vadose zone

*Public health impacts*

There are no public health impacts from the Sr-90 plumes. The contamination is contained within the BNL boundaries and the existing systems coupled with modeling indicate that the plumes will not migrate off-site.

### *Economic impacts*

The current Sr-90 treatments systems are effectively controlling the Sr-90 plumes on site. The issue is that this is requiring more time than originally estimated which leads to higher costs. Sr-90 currently in the vadose zone above the water table continues to act as a continuing source to the aquifer. This effect is pronounced when the water table rises and encounters Sr-90 contaminated soils. To reduce the time for active operation requires either: a) removal of the vadose zone source term or b) capping at the surface to reduce the rate of water flow and thereby the flux of water (and Sr-90) to the aquifer. However, finding the exact location of the source would be extremely difficult (particularly beneath the BGRR) and even with a cap, a rising water table will continue to add strontium to the vadose zone until the soil in the zone of water table fluctuation is depleted of Sr-90.

## 5) Conclusion

The existing treatment systems are successfully capturing the Sr-90 plumes; however the cleanup period is longer than originally anticipated. This is primarily due to the continued release of Sr-90 from the vadose zone to the aquifer, which was not accounted for in the modeling. Efforts to locate the source in the vadose zone and/or reduce infiltration through capping, if successful, will reduce the time required for active pumping to remove strontium. Other DOE sites have turned to permeable reactive barriers. Use of a permeable reactive barrier at BNL is probably not feasible due to the absence of a competent geologic layer to tie into and the high initial cost of barrier installation. This will be reviewed in five years if the duration of cleanup of the strontium plume remains a concern.

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# Memo

*date:* *October 1, 2015*
*to:* *Bill Dorsch*
*from:* *Terry Sullivan*
*subject:* Ethylene Dibromide (EDB) Review

## 1) Introduction

As part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Environmental Protection Agency (EPA) requires a review of Brookhaven National Laboratory's (BNL) environmental remediation efforts on a five year cycle. Initial modeling of the transport rate of Ethylene Dibromide (EDB) suggested that the system could be turned off in 2015. The current data do no support this and it will take several more years to reach cleanup goals. For this reason, a review of EDB treatment technologies at other sites was conducted to examine if viable options exist to remediate the plume in a shorter time frame without large cost implications. The evaluation criteria are:

- Advancements in cleanup technologies
- Changes in standards and regulations for worker, public, and environmental protection
- Environmental impacts
- Public health impacts
- Economic impacts

If this technical review identifies a remediation method that demonstrates the potential to be implemented that shows substantial improvements to the above criteria, analysis of that potential method will be initiated and possibly implemented.

## 2) Review of EDB Treatment system

EDB was used as a fumigant in 1970's in the Biology Fields in the southeastern portion of the BNL site. Sampling in 1995 and 1996 detected low-levels of EDB above the drinking water standard of 0.05 μg/L in the groundwater near these fields. Higher concentrations were found near the southern boundary and off site to the south. The depth of the plume decreased as the plume migrates southward.

The OU VI EDB treatment system contains two extraction wells and two recharge wells that have been operational since August, 2004. Extracted groundwater is passed through a granulated activated carbon filter before being used for recharged. All equipment, including the treatment building is located off site near the extraction wells. EDB has not been detected on site since 2009. This is important because it indicates the source has been depleted and when the capture goals are met, it should remain that way.

The monitoring system consists of twenty-five wells. Five wells that are in the main part of the plume are sampled quarterly, while other wells are sampled semi-annually. The trailing edge of the plume is south of North Street and extends approximately 3000 feet to the extraction wells. Peak concentrations in the plume remain above 1 µg/L while the cleanup standard is 0.05 µg/L. The region of highest concentrations in the plume extends back approximately 1500 feet from the extraction wells.

Original model estimates of the time required for remediation suggested that 8 to 10 years would be sufficient (BNL, 2004). The system has been operating for 11 years and will require several more years to reach the cleanup goal. For this reason, a review of other EDB plumes and treatment technologies was conducted to determine if an approach was available to speed up the process.

## 3) EDB Treatment Systems at Other Sites

EDB was used as a pesticide and as a component of lead based gasoline and aviation fuel that reduced engine knock. Florida stopped the sale of produce contaminated with EDB in 1983 and banned its use after that time. Florida still has EDB groundwater contamination problems more than 30 years after stopping its use. This reflects the persistence of EDB in groundwater system and the low rates of biodegradation in many subsurface environments. A study for the State of South Carolina showed that over ½ of the Underground Storage Tanks with leaks have EDB groundwater concentrations above the drinking water standard of 0.05 µg/L (Falta, 2006). EDB is still used as a gas additive. Several large military complexes including Otis Air Force Base (now known as Joint Base Cape Cod - JBCC), Kirtland Air Force Base in New Mexico, and the Kitsap Naval Base in Washington have had major spills leading to EDB plumes with concentrations above the drinking water standards that are over approximately one mile in length and 2000 feet wide. This represents several billion gallons of contaminated water. These plumes have migrated off site leading to concerns by the general public.

In 2006, EPA conducted a review of BTEX contaminants including EDB. They found that the treatment technologies used most often for EDB contaminations are air sparging, soil vapor extraction (SVE), and pump and treat (P&T) with granular activated carbon. Air sparging and SVE are frequently used in the source zone and when the contamination is near the surface. Deep groundwater plumes are treated using P&T.

The two largest spills of EDB were at Otis National Guard and Kirtland Air Force Base. At the JBCC (Otis Air Force Base) an aviation fuel pipeline leaked approximately 70,000 gallons. This was identified as Fuel Spill 12. Other large fuel spills occurred at this site as well. Groundwater contamination was discovered in 1990 when the nearby public water district detected hydrocarbon odors in two exploratory wells installed off base. BTEX and EDB were identified in the plume. The source area was 11 acres in size and the resulting plume was 4800 feet long, 2000 feet wide and 60 to 130 feet thick. The depth of this plume is 150 – 250 feet below ground surface. The plume had a maximum EDB concentration of 600 µg/L. Air sparging and SVE were used from 1995 to 1998 to remediate the source zone. During operation 23 air sparging wells and 23 extraction wells were in operation. Approximately 45,000 pounds of BTEX and EDB were removed from the soil.

A P&T system is currently in operation at JBCC. The 1995 interim ROD, which selected P&T as a remedy, set the cleanup goal for EDB in groundwater at 0.02 µg/L based on the state MCL. The initial P&T system includes 25 extraction wells and 23 reinjection wells. The P&T system started operating in September 1997 and treated over 1 million gallons of groundwater per day. Extracted groundwater is treated using granular activated carbon to remove organic contamination and the water is reinjected into the aquifer. As of January, 2015 the Fuel Spill 28 treatment system was down to 2 wells operating at a total of 550 gpm. Two other systems are in place to treat EDB contamination from fuel spills.

The original modeling at the JBCC site suggested that the P&T system would need to be in operation for approximately ten years. However, further characterization showed the plume to be much more widespread than the original estimate. The system has been in operation for 20 years. The longer time required to clean up the plume prompted JBCC to examine in-situ treatment options.

Kirtland Air Force Base in Albuquerque New Mexico also had a large undetected leak of aviation fuel oil. The use of EDB in fuel was stopped in 1975. In 1990 characterization data showed elevated EDB and benzene. Further characterization shows that currently the plume reaches just off base at concentrations in excess of 1000 µg/L. The cleanup level required by the EPA and State of New Mexico is 0.05 µg/L. The plume extends several thousand feet further at this level. EDB has not been detected in the supply wells. In 2003 a soil vapor extraction system was installed to remove contamination from the vadose zone. It has removed 500,000 gallons of fuel since operation started. They have recently decided to install a P&T system with granular activated carbon. The clean water will be recharged to the aquifer. The system will contain up to 8 extraction wells with a total pumping rate of 600 – 800 gpm. The objective of this system is to shrink the size of the EDB plume and prevent the leading edge of the plume from entering the supply wells.

## 4) Options to Improve Treatment

The long treatment time required for P&T motivated JBCC to search for in-situ treatment techniques. In 2011 attempts to find a method for enhanced biodegradation of EDB at the JBCC were made (McKeever, 2011). In laboratory studies they added a 50 millimole (mM) phosphate buffer to water at pH 7 and 15 ºC. This reduced the half-life of EDB from 22 years to approximately 16 years. A slight improvement, but this was insufficient to justify the costs. In further laboratory studies, the addition of 1mM sulfide to the 50 mM phosphate buffer at 15 ºC further reduced the half-life of EDB to 160 days. Biotic hydrolysis (biodegradation) of EDB is enhanced in the presence of a natural catalyst such as $H_2S$ or the bisulfide ion (HS), with the time required for hydrolysis decreasing from several years to approximately 2 months (Martin, 2011). Ethylene glycol and bromide ions are major products of the hydrolysis reactions. Although this approach showed promise, it was not tried in the field.

CB&I (formerly Shaw Environmental) conducted laboratory and field work to develop a biodegradation technique using indigenous bacteria. The objective of this project was to evaluate options to enhance the aerobic degradation of EDB in groundwater, with a particular focus on possible *in-situ* remediation (CB&I, 2014). Laboratory studies conducted with aquifer solids and groundwater from the FS-12 plume at JBCC revealed that the addition of ethane gas, nutrients, and oxygen resulted in the rapid biodegradation of EDB, and a culture capable of biodegrading EDB (*Mycobacteriumsphagni* ENV482) was subsequently isolated from the site. Based on the laboratory results, a field-scale *in-situ* groundwater treatment system was designed, installed and operated at JBCC. This system captured a side stream of extracted groundwater from the FS-12 plume (~10 GPM from a 120 GPM extraction well), added ethane gas, oxygen and inorganic nutrients into the extracted side stream, and then recharged the groundwater at an upgradient well, creating an active treatment zone. A series of nested monitoring wells were installed to evaluate system performance. After 4 months of active operation (following a 3 month mixing and equilibration period) EDB concentrations declined from ~0.3µg/L to < 0.02 µg/L, the Massachusetts MCL, in six of the pilot monitoring wells. Moreover, complete consumption of ethane and nutrients occurred throughout the treatment plot. The researcher's concluded that the data indicate that aerobic cometabolism using ethane gas can be a viable option to sustainably treat EDB to below regulatory MCLs in the JBCC aquifer.

## D) Review of criteria for changing the current plans.

Two potential alternatives exist for increasing the rate of remediation: in-situ treatment as performed at JBCC or adding additional treatment wells.

- ***Advancements in cleanup technologies and transportation methods***

The recent successful EDB biodegradation tests at JBCC indicate that a similar approach may work at BNL. The contaminant depth (150 – 250 feet below ground surface) and aquifer at JBCC is similar to that at BNL which suggests that the potential for a similar approach working at the BNL site is high.

- ***Changes in standards and regulations for worker, public, and environmental protection***

There has not been a change in the standards for worker, public or environmental protection in the last five years. Although these may change in the future, there is no current activity to change existing limits and regulations.

- ***Environmental impacts***

The EDB levels are currently above the drinking water standards. However, the monitoring data collected over the past ten years suggests that the existing pump and treat system will capture the plume and meet the standards within 4 years. This indicates that further action is not necessary if BNL wishes to operate the system for the additional time.

- ***Public health impacts***

There are no public health impacts from the EDB plume. The contamination is not found in any drinking water wells and there is no exposure to the public. The existing system will prevent EDB from reaching any drinking water well.

- ***Economic impacts***

The current O&M costs for the EDB treatments system, comprised of two wells, a granular activated carbon (GAC) treatment building, and discharge wells consists of two components, rent for the land use and the typical O&M including sampling, testing, change out of the carbon filters and routine maintenance. Rental cost for land access to this treatment system is currently split between two projects and is $85,000 per year for the EDB plume. However, one project will end in 2019 and the EDB remediation will pay the entire rental cost of $165,000 in 2019. Thus, there is strong incentive to complete the project as soon as possible. The annual O&M costs are around $160K. This makes the current operating costs around $245,000 per year. Provided that typical O&M costs remain the same, the annual operating cost will increase to $325,000 in 2019.

A reduction in the time required to remediate the plume could be obtained by installing new treatment wells upgradient of the existing wells and near the building that houses the treatment system. Installation of two extraction and three monitoring wells with the associated connections to power and piping to move the extracted water to the treatment system would cost approximately $272,000. The current GAC treatment system is rated at 400 gpm. Thus, the four wells could operate at 100 gpm without upgrading the system. The existing extraction wells averaged a withdrawal rate of 312 gpm in 2013. Thus, their withdrawal rate and capture zone would need to be reduced. An evaluation of whether a flow rate of 100 gpm from four wells would be sufficient would be needed before proceeding without upgrading the treatment system. If the treatment system needs to be expanded, that would cost approximately $100,000. It is anticipated that the O&M costs would increase by $60,000 per year to handle the two additional extraction wells. Therefore, the additional cost in the first year would be $332,000 with an incremental cost of $60,000 per year after that.

The current plans anticipate being able to stop the treatment system in 2019. To get a positive return on investment would require being able to shut down the treatments system at least 2 years earlier than the existing system. Table 1 shows the costs for the current system and the potential new system over time assuming the new system begins in 2016. Examining the table, a positive return on investment is obtained when the total expenditure for the new system is less than the old system. If the new system is started in 2016 this would mean that the system would need to be shut off in 2017. From Table 1, the cost of operating the existing system through 2019 is $980,000 while the cost of operating the new system to 2017 is $882,000. If the project slips such that shutdown occurs after 2019 the results are the same and the new treatment system would need to bring the shut down time to two years earlier than with the current system, however the economic advantage of the new system decreases over time due to the increased O&M costs ($60,000 per year) for the additional wells. Eventually, the new system would have to allow shut down more than 2 years earlier to account for these costs as seen by comparing the costs of the existing system in 2023 ($2,228,000) to those of the new system in 2021 ($2,226,200).

**Table 1 Projected costs for existing and new treatment systems for EDB plume**

| | Total Cost ($1000) | |
|---|---|---|
| **Year** | **Existing** | **2 new wells** |
| 2016 | $245 | $577 |
| 2017 | $490 | $882 |
| 2018 | $735 | $1,187 |
| 2019 | $980 | $1,492 |
| 2020 | $1,305 | $1,877 |
| 2021 | $1,630 | $2,262 |
| 2022 | $1,955 | $2,647 |
| 2023 | $2,280 | $3,032 |

A detailed analysis of the potential reduction in the operational period would be needed to verify that the additional wells could lead to a two year reduction. Considering that the expected operational period is only until 2019 and the marginal savings (~$100,000) if everything went as planned and that improvements to the treatment center were not needed, it is hard to justify the addition of two new treatment wells.

The approach at JBCC shows great promise. However, it has not been tested at BNL and there is some uncertainty as to its effectiveness at BNL. The in-situ treatment would require research to identify native bacteria to use for the bioremediation, a test demonstration, and additional wells. Prior to attempting an enhanced biodegradation system, similar to the test at JBCC, the costs of such an approach need to be considered. The pilot test at JBCC cost $560,000. Additional costs would be incurred for the nutrients and additional operation and maintenance (O&M) that would be required for the additional wells. Given the anticipated time frame until the current system is predicted to meet cleanup goals (2019) the costs for proof of principle at BNL and additional risk of the in-situ treatment not performing as desired this approach is not cost-effective for BNL.

## Conclusion

The existing treatment system is successfully capturing the EDB plume, however at a slower rate than originally anticipated. Two treatment options, enhanced in-situ biodegradation or adding new treatment wells, could reduce the amount of time required to reduce the EDB concentrations below the drinking water standard of 0.05 μg/L in the aquifer. It appears that that the current approach is the most cost effective in meeting the cleanup goals. This will be reviewed in five years if the EDB plume remains a concern.

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# Memo

*date:* *October 1, 2015*
*to:* *Bill Dorsch*
*from:* *Terry Sullivan*
*subject:* *High Flux Beam Reactor (HFBR) Review*

## 1) Introduction

As part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Environmental Protection Agency (EPA) requires a review of Brookhaven National Laboratory's (BNL) environmental remediation efforts on a five year cycle. As part of this review an evaluation of the remediation of the High Flux Beam Reactor (HFBR) is required (BNL, 2009). The 2007 High Flux Beam Reactor (HFBR) Feasibility Study (FS) provided several options for decontamination and decommissioning (D&D) of the HFBR (BNL, 2007). The cleanup alternative that best balances the National Contingency Plan's remedy selection criteria was Phased Decontamination and Dismantlement with Near-Term Control Rod Blade Removal. This alternative is known as Alternative C in the Proposed Remedial Action Plan. The selected remedy involves land use and institutional controls (LUICs) to protect the site and surveillance and maintenance (S&M) to allow radioactive decay to reduce the dose rates to levels that minimize risk to workers and minimize costs associated with D&D.

The Record of Decision (ROD) states that the Department of Energy will conduct five-year technical reviews of the remedy in accordance with DOE five-year review guidance to determine the feasibility of reducing the safe storage (decay) period and completing the HFBR cleanup earlier taking into consideration the following factors (BNL, 2009):

- Advancements in cleanup technologies and transportation methods
- Availability of waste disposal facilities
- Changes in standards and regulations for worker, public, and environmental protection
- Worker safety impacts
- Environmental impacts
- Public health impacts
- Economic impacts
- Land use
- Existing stabilization and safety of the facility and hazardous materials
- Projected future stability and safety of the facility and hazardous materials

If this technical review identifies a remediation method that demonstrates the potential to be implemented before the selected decay period ends while showing substantial improvements to the above criteria, analysis of that potential method will be initiated and possibly implemented.

## 2) Review of Remedy Selection

In 2007 the estimated inventory of the HFBR complex was 65,000 Curies and the peak dose rate from the most activated component was close to 1000 Rem/hr at a distance of one foot in air. The most radioactive components were the thermal shield, control rod blades, and reactor internals. The activated components are large and would require cutting to fit into transportation casks. The initially high dose rate would make handling of the activated components difficult and would require cutting operations to be performed under water to provide shielding. The nuclear industry standard to separate a high radiation area from a radiation area is a dose rate 100 mrem/hr at 1 foot in air. For this reason, a dose rate of 100 mrem/hr was chosen as the level to begin dismantlement of the reactor components if a long storage period was selected. Figure 1 shows the predicted dose rate at 1 foot from the major reactor components over time. The dose rate from the highest activity component will decrease below 100 mrem/hr in 2072.

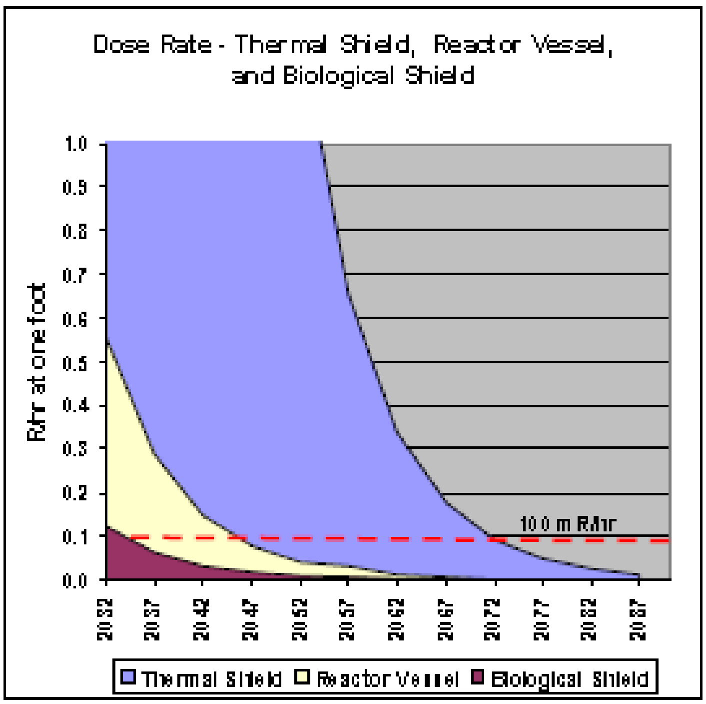


**Figure 1 Predicted dose rate in various components in 2032 - 2087.**

In the Feasibility Study four potential remediation approaches were considered:

a) ***No Additional Action*** would include those actions already completed. Alternative A would also include the continuation of S&M and the use of LUICs for an indefinite period of time to ensure the protection of human health and the environment.

b) ***Phased Decontamination and Dismantlement*** would include the near-term removal, by Fiscal Year (FY) 2020, of the HFBR ancillary structures as described in Section 1.2, contaminated underground duct and piping systems, and small areas of contaminated soil outside the confinement building footprint. The activated components would remain in place inside the confinement building for a decay period not to exceed 65 years to allow for the natural decay of these high dose rate radioactive components. At the conclusion of this radioactive decay period, the balance of the HFBR complex would be dismantled and removed. This alternative provides for the complete removal of the HFBR complex with the possible exception of the subsurface concrete structures of the confinement building base mat and stack foundation. However, the final decision to leave either of these sub-structures in place will be determined on the basis of radiological sampling and dose assessment. Alternative B would also include the continuation of S&M and the use of LUICs throughout the period of radioactive decay to ensure the protection of human health and the environment. The cleanup, after dismantlement of the confinement building, would satisfy the dose-based cleanup goal of 15 mrem/year and methodology specified in the Operable Unit I (OU I) ROD. After dismantlement, there will be no need for any additional period of LUICs.

c) ***Phased Decontamination and Dismantlement With Near-Term Control Rod Blade Removal,*** consists of the same actions as those included in Alternative B. Alternative C results in the same end state as that of Alternative B, the complete removal of the HFBR complex. The difference is limited to the timing of the decontamination and dismantlement activities. Alternative C would include the near-term removal of the HFBR ancillary structures, contaminated underground duct and piping systems, and small areas of contaminated soil. Alternative C also includes the near-term removal, transportation, and disposal of the CRBs and beam plugs by FY 2020.

d) ***Near-Term Decontamination and Dismantlement,*** includes the complete near-term removal of the HFBR complex by FY 2026.

Alternative C was selected as the Selected Alternative, This plan removes the control rods and beam plugs by 2020, stores the remaining reactor structure and activated components for 65 years (until 2073) and removes the remaining equipment at that time.

## 3) Actions to Date

After the reactor shutdown in 1998 BNL has made significant efforts to remove and dispose of contaminated components, structures, water, and soil at the HFBR complex. These include:

- The spent fuel was removed and sent to an off-site facility (1998).
- The primary coolant (heavy water) was removed and sent to an off-site facility (2001). Scientific equipment was removed and is being reused or has been sent to an off-site disposal facility (2003).
- Shielding and chemicals were removed and are being reused at BNL and other facilities (2000--2005).
- The cooling tower superstructure was dismantled and disposed of as waste in 1999.
- The confinement structure and spent fuel canal were modified to meet Suffolk County Article 12 requirements (2004).
- Stack monitoring facility (Building 715) was dismantled and removed (2006).
- Cooling tower basin and pump/switchgear house (Buildings 707/707A) were dismantled and removed (2006).
- Water treatment house (Building 707B) was dismantled and removed (2006).

- Cold neutron facility (Building 751) contaminated systems were removed and the clean building has been transferred to another BNL site organization for re-use (2006).
- Guard house (Building 753) was dismantled and removed (2006).
- Cleanup of the Waste Loading Area and removal of Building 801-811 waste transfer lines (A/B waste lines with co-located piping) and associated soil were completed and documented in completion/closeout reports (2009).
- Stabilization activities for the HFBR confinement building (Building 750) were completed (2009 – 2010).
- Control rod blades and beam plugs were removed and disposed (2009).
- The HFBR underground utilities and associated contaminated soils were removed and disposed. (2010).
- Final Status Survey (FSS) and Independent Verification Survey (IVS) were completed for HFBR outside Areas (2010).
- The Fan Houses (Buildings 704 & 802) were dismantled, the associated contaminated soil was removed and project wastes were disposed (2010 – 2011).

In addition to removal actions the HFBR operates with Land Use and Institutional Controls to prevent unintended access to the site and routine surveillance and maintenance (S&M).

**HFBR Land Use and Institutional Controls (LUICs)**
The HFBR remedy includes the continued implementation of LUICs in accordance with the LUCMP.
These include:

- Measures for controlling future excavation and other actions that could otherwise disturb residual subsurface contamination.
- Land use restrictions and an acceptable method for evaluating potential impact that the remaining contaminants have on future development.

Periodic certification to EPA and NYSDEC stating that the institutional and engineering controls put in place are unchanged from the previous certification, and that nothing has occurred that would impair the ability of the control to protect public health or the environment or constitute a violation or failure to comply with the site management plan.

**HFBR System Operations/O&M**
Long-term S&M activities are being conducted in accordance with the *Long-Term Surveillance and Maintenance Plan for the HFBR (BNL 2010a*) to ensure effectiveness of the remedy. The BNL LUCMP contains site wide control measures and land-use restrictions to prevent exposure to environmental contamination and to protect the integrity of remedies specified within the ROD.

**4) Review of Improvements in Decontamination Techniques and Decommissioning Activity**

Decommissioning of nuclear reactors is primarily a deconstruction project. As such the field is mature and the technologies for cutting, scabbling, and other surface removal processes have been used for many years. In communications with Larry Boing, Decommissioning Subject Matter Expert at Argonne National Laboratory, he said the major advances have been in cutting and scabbling tools using pressurized liquid nitrogen. The advantages of these tools are that they can be remote operated, have a high efficiency (>95%) waste collection, they do not use chemicals, do not produce a secondary waste stream, and do minimal damage to the surface. The operating speed for cutting or scabbling is better than conventional techniques. The equipment has been hardened to allow use in a nuclear facility. The main disadvantage of the system is expense. For large jobs, the increased operating rates can lead to cost savings. While this tool is an improvement over existing tools, it cannot be used underwater as would be required for the activated components of the HFBR. Mr Boing stated that there has not been any major improvement in underwater cutting techniques in the last five years.

Long term storage of nuclear facilities prior to dismantlement and decommissioning is a common practice in the U.S. commercial sector. Currently three power plants are undergoing decommissioning while twelve plants are in long-term storage. A major concern with commercial power plants is that there is no disposal pathway for spent fuel. This causes all of the power plants to develop an Independent Spent Fuel Storage Installation (ISFSI). The ISFSI are often a cause for public concern as the facility becomes a defacto spent fuel storage facility. Vermont Yankee Nuclear power plant stopped operations in December 2014 planning for long term storage before decommissioning. The potential presence of the ISFSI has led to major public concerns and the local community is trying to find a way to make the site owners remove the fuel from the site.

Savannah River has used an entombment process for decommissioning their nuclear reactors. In this approach, all below grade piping is filled with concrete and left in place. The reactor fuel is removed and the remaining core structure is also filled with concrete. Above grade equipment is removed from the building. This technique reduces the decommissioning costs by a factor of about 4. However, the entombed reactors are effectively low-level waste disposal sites, which are not allowed in New York State.

At the DOE Hanford site they have used the process of “cocooning” for interim safe storage (ISS) before decommissioning. Cocooning is the process of demolishing all but the shield walls surrounding the reactor core, removing or stabilizing all loose contamination within the facility, and placing a new roof on the remaining structure. A single doorway in the structure is installed to provide access for surveillance and maintenance work. This doorway is welded shut, and all other openings in the shield walls are sealed to prevent intrusions and the release of radioactive materials. The facility is inspected every five years and remotely monitored at all times for changes in moisture and temperature. Cocooning was chosen at Hanford to reduce the foot print and remove any concerns with the concrete buildings built in the 1940’s and early 1950’s. The structural stability of the HFBR hemispherical dome is sound and removal of the dome is problematic as compared to the rectangular walls for the Hanford Reactors. The eight reactors at the Hanford site were originally supposed to undergo safe storage for 75 years prior to a one-piece removal action and disposal at the Hanford site. The original cost estimates for this approach were much less than for dismantlement and disposal. Experience in the one-piece removal of two other reactors showed that the costs were more expensive than originally estimated and costs are comparable to the dismantlement and disposal approach. Therefore, the Hanford site has received agreement to consider dismantlement and disposal within 20 years. At this time, it is still planned to store the reactors for 75 years.

## D) Review of DOE requirements for changing the current plans.

- ***Advancements in cleanup technologies and transportation methods***

Removal of the reactor and its components would require underwater cutting for size reduction to fit into shipping containers. There have been no major advances in this field in the past several years. However, operating experience has improved and the process has become more efficient in minimizing cloudiness in the water due to cutting debris.

- ***Availability of waste disposal facilities***

The availability of waste disposal facilities has not changed. This option is likely to remain available in the future. The larger more radioactive pieces of waste will be disposed of at a DOE facility. Smaller less radioactive waste may be disposed of at a commercial facility. The country needs at least one commercial facility to handle medical wastes and wastes from nuclear power plants. Therefore, commercial capacity is likely to be available in the future.

- ***Changes in standards and regulations for worker, public, and environmental protection***

There has not been a change in the standards for worker, public or environmental protection in the last five years. Although these may change in the future, there is no current activity to change existing limits and regulations. There has been activity to revise 10 CFR part 61, the Nuclear Regulatory Commission's, regulations for low-level waste disposal. The proposed changes primarily address waste acceptance criteria and the time period for performance assessment. Protective limits in the proposed revised standard are unchanged.

- ***Worker safety impacts***

The current concept for storage until 2073 is more protective of the worker than removal at an earlier time. Earlier removal will cause higher worker dose and risk.

- ***Environmental impacts***

The activated materials are contained within the HFBR structure and do not provide an immediate environmental risk. To confirm that the storage process does not degrade the environment, an active Surveillance and Maintenance (S&M) program monitors for groundwater contamination from the building. Periodic inspections of the building interior are performed to confirm there is no water intrusion and that major degradation of the reactor structure is not occurring.

- ***Public health impacts***

There are no public health impacts from the long-term storage of the HFBR. Over 99% of the radioactivity is in the activated components of the reactor. These components are encased in the biological shield which is made of eight feet of steel reinforced concrete. There are several physical barriers to the site that prevent access of the public to the areas of contamination. The S&M program monitors the air, soil, and groundwater around the HFBR to confirm that release is not occurring and that the public is not impacted.

- ***Economic impacts***

The FS examined costs for each remedial option. The option to remove all of the components by the year 2025 was $205M, while the cost for the selected alternative was $144 M. The selected alternative involved removing the beam plugs and storing the reactor for 65 years. This storage time allows for substantial radioactive decay that leads to reductions in worker dose, shipping costs, and disposal costs.

- ***Land use***

The HFBR is located within BNL boundaries. BNL is a DOE research facility and is expected to remain so for the foreseeable future. Access to the BNL site is restricted and controlled. The use of this land for safe storage does not impact other operations at BNL. BNL has adequate land to expand as research and operational needs dictate and the long-term storage at the HFBR facility is not an issue.

- ***Existing stabilization and safety of the facility and hazardous materials***

The existing facility is stable and undergoes a routine surveillance and maintenance plan. The air, soil, and groundwater around the facility are monitored to make sure that releases of hazardous or radioactive materials are not occurring.

- ***Projected future stability and safety of the facility and hazardous materials***

Access to the site is controlled. The facility will be maintained following the agreed upon Surveillance and Maintenance Plan. If conditions change in the future actions will be taken to ensure the stability of the facility.

Additional reasons that could lead to a reduction in the storage time include:

a) The desire by DOE to reduce institutional risks at an earlier time
b) Concerns over the stability of the HFBR facility, and
c) Discovering that the initial estimates of radioactivity remaining in the structure are biased high. The original estimates were based on calculations that require a detailed operational history and knowledge of the exact composition of the radiological components. The calculated estimates are then compared with the measured radiation field and refined if there is not good agreement.

The original determination by DOE was that the additional cost (>$50 million) for earlier removal was not sufficient to select to remove the equipment sooner to reduce institutional risks at an earlier date. Additionally, worker risks would increase with earlier removal and this is not desireable.

At the current time, there is little public pressure to remove the reactor components at an earlier time. The facility has controlled access and is monitored for releases of radioactive material and undergoes an active surveillance and maintenance program. Any issues must be reported to federal and state regulators.

As part of the surveillance plan, measurements of the radioactivity level in the reactor core are made every five years (BNL, 2012). Dose rate measurements were made in 2009 during the Control Rod Blade removal process (BNL, 2010). The measured values were within the expected range based on calculations. Additionally, radiation measurements were made of the control rod blades and end plugs when they were removed in 2009. The control rod blades contained two parts, the main control rod blade and the auxiliary control rod blade. Predicted dose rates were within 1% on the main control rod blade and 8% on the auxiliary control rod blade. This agreement suggests that the selected decay period is appropriate.

Radiation measurements of the V-14 port were conducted in 2010 and 2015 as a means to confirm that radioactive decay is occurring at the modeled rate. The V-14 port is at the top of the reactor vessel. An AMP-100 probe is lowered into the port to depths of 2, 4, and 10 feet. The measured radiation dose is recorded at each level and provided in Table 1.

**Table 1 Measured radiation doses at the V-14 port.**

| Depth (ft) | Dose (mr/hr) Sample Date (6/29/2010) | Dose (mr/hr) Sample Date (6/3/15) |
|---|---|---|
| 2 | 0 | 0 |
| 4 | 2 | 3 |
| 10 | 12 | 6 |

Characterization and modeling suggest that the gamma dose measured by the probe is primarily from Co-60 with a 5.27 year half-life. Thus, it is expected that the dose will decrease by approximately a factor of 2 in the five years between measurements. The reading at 10 feet does show a factor of two decrease as expected. The reading at 4 feet shows an increase in dose between 2010 and 2015. This is likely due to measurement error as the inventory of radioactivity could not have increased over this time period. Attention should be paid to this reading in subsequent measurements. Additionally, it would be beneficial to report the dose rate to tenths of mr/hr to aid future evaluations of the decay rate. To summarize, the data at ten feet down the V-14 port suggest that decay is occurring as expected and the selected decay period (until 2073) is justified.

## Conclusions

Based on the evaluation criteria specified in the ROD (BNL, 2009) and the match between the predicted and measured dose rates there is no reason to alter the current remedial action plan. This will be reviewed in five years.

## References

BNL, 2007, Feasibility Study, Brookhaven High Flux Beam Reactor, Decommissioning Project, prepared by Brookhaven Science Associates for the U.S. Department of Energy, September 2007.

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BNL, 2010a, Long-Term Surveillance and Maintenance Plan for the High Flux Beam Reactor (HFBR) Brookhaven National Laboratory, New York, Rev 2, November, 2010.

BNL, 2012, Long-Term Surveillance and Maintenance Manual for the High Flux Beam Reactor (HFBR), Brookhaven National Laboratory, New York, Rev 3, November, 2012.

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# Memo

*date:* *October 1, 2015*

*to:* *Bill Dorsch*

*from:* *Terry Sullivan*

*subject:* *Review of Changes in the Soil Cleanup and Drinking Standards*

## Background

Brookhaven National Laboratory as part of its remediation strategy sets cleanup goals based on New York State and the U.S. Environmental Protection Agency (EPA) guidance for soil and groundwater contamination. Nationally, the relevant law is the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Regulations establishing ground water quality standards in New York State (NYS) were first passed in 1967. These regulations continue under authority of NYS Environmental Conservation Law and are enforced by DEC. Under NYS law DEC maintains these standards as part of its charge to protect the waters of the state. The NYS water quality standards program is a state program with federal (U.S. EPA) oversight. New York's longstanding water quality standards program predates the federal Clean Water Act and protects both surface waters and groundwaters.

The CERCLA framework includes the expectation that contaminated ground waters will be returned to beneficial uses whenever practicable. Section 121(d) of CERCLA requires on-site remedial actions to attain Maximum Contamination Level Goals (MCLGs) and water quality standards under the Clean Water Act when relevant and appropriate. The National Oil and Hazardous Substances Pollution Contingency Plan clarify that Maximum Concentration Level (MCLs) or non-zero MCLGs established under Safe Drinking Water Act will typically be considered relevant and appropriate cleanup levels for ground waters that are a current or potential source of drinking water. In most cases, the MCLs in the State and Federal laws are identical.

The risk from soil contamination depends strongly on many site-specific parameters such as the exposure pathways and time of exposure. For this reason, soil cleanup levels are determined on a site-specific basis. Guidance on how to calculate site-specific soil cleanup levels is provided by both EPA and NYS.

## Groundwater

EPA specifies the MCLs for groundwater contamination in their National Primary Drinking Water Regulations. MCLG and MCL values are provided for microorganisms, disinfectants, disinfectant byproducts, inorganic chemicals, organic chemicals, and radionuclides (http://water.epa.gov/drink/contaminants/index.cfm#List). These primary standards were last updated in May, 2009.

The NYSDEC filed a Notice of Adoption for amendments to the water quality standards regulations (6 NYCRR Parts 700-704) with the New York State Department of State on January 17, 2008. The regulations became effective on February 16, 2008 (30 days after filing). The latest amendment to the NYS water quality standards regulations (6 NYCRR Parts 700-706) (http://www.dec.ny.gov/chemical/23853.html) includes new Health (Water Source) standards for metolachlor, acetaldehyde, formaldehyde, and carbon disulfide; a new aquatic life standard for ammonia (marine waters); a revised standard for dissolved oxygen for most marine waters; new or revised groundwater effluent limitations; and a new narrative standard for flow for all fresh waters (http://www.dec.ny.gov/chemical/27985.html). The MCLs are covered in Section 703.5, Table 1 of the standard and can be found at: https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default).

New York State water quality standards regulations are currently being revised. The key components being considered for revision can be found at (**http://www.dec.ny.gov/chemical/86605.html**) and include potential revisions to the MCL values found in Table 1 of Section 703.5.

There are differences in the treatment of radionuclides between EPA and NYS. EPA Guidance on radionuclide limits are based on a total effective dose equivalent of 15 mrem/yr (EPA, 1997) with a maximum of 4 mrem/yr from groundwater. New York State uses the maximum dose to any organ to set MCLs for radionuclides. This leads to a more stringent value than in the EPA approach for Sr-90 due to the affinity for strontium to enter the bones.

**Table 1 Comparison of EPA and NYS MCL values for radionuclides.**

| Radionuclide | EPA MCL | NYS MCL | Comments |
|---|---|---|---|
| Gross Beta emitters* | 4 mrem/yr | 1000 pCi/L | NYS excludes Strontium and alpha emitters. |
| Gross alpha | 15 pCi/L | 15 pCi/L | Excludes Uranium and Radium/Radon |
| Gross photon* emitters | 4 mrem/yr | | |
| Uranium | 30 µg/L | 5000 µg/L | NYS applies only to Uranyl ion. |
| Sr-90 | N/A | 8 pCi/L | EPA regulated under the gross beta emitter category. |
| H-3 | N/A | 20,000 pCi/L | EPA regulated under the gross beta emitter category. |

* The total dose from all Beta/photon emitters must be less than 4 mrem/yr. A total of 168 individual beta particle and photon emitters may be used to calculate compliance with the MCL.
Gross alpha 15 pCi/L, excluding Radon and Uranium
Gross Beta 1000 pCi/L, excluding Sr-90 and alpha emitters
Strontium 8 pCi/L. If two or more radionuclides are present, the sum of their doses shall not exceed an annual potential dose of 4 mrem/yr.

## Soils

Soil cleanup levels are determined on a site-specific risk based analysis. EPA provides guidance on how to calculate soil cleanup levels (U.S. EPA, 1996a; 1996 b). NYS updated their cleanup guidance in 2010 with a DEC policy, CP-51, Soil Cleanup Guidance (http://www.dec.ny.gov/docs/remediation_hudson_pdf/cpsoil.pdf) . Both approaches provide a uniform and consistent process to determine soil cleanup levels. Tables 1 - 3 of CP-51 provide generic cleanup levels for different types of contamination. Table 1 provides Supplemental Soil Cleanup Objectives for metals, pesticides, semi-volatile organic compounds, and volatile organic compounds. Tables 2 and 3 provide Soil cleanup Levels for Gasoline (Table 2) and Fuel Oil (Table 3) contaminated soils.

New York State guidance for radioactively contaminated soils can be found in Cleanup Guidelines for Soils Contaminated with Radioactive Materials (DER-38) (http://www.dec.ny.gov/regulations/23472.html). The NYS policy, last updated in April 2013, limits the total effective dose equivalent to the maximally exposed individual of the general public, from radioactive material remaining at a site after cleanup, shall be as low as reasonably achievable and less than 10 mrem above that received from background levels of radiation in any one year. The 10 mrem standard has not been changed from previous guidance.

The radiation dose received from an exposure to soils contaminated by radionuclides will strongly depend on the time of exposure and pathways by which the radionuclides or their decay products can come in contact with an individual. For this reason, the estimated annual dose resulting from exposure to any residual radionuclides in the contaminated area is the basis for establishing site-specific cleanup criteria.

## Summary

There have been no substantial changes to the regulations since 2010. Groundwater MCL values were last updated in 2008 (NYS) and 2009 (EPA). Guidance for radioactively contaminated soils has been issued in 2013 (NYS) but the dose limit that was used to set BNL cleanup levels has not changed.

## References

U.S. EPA. 1996a. *Soil Screening Guidance: User's Guide*, Office of Emergency and Remedial Response, Washington, DC. EPA/540/R-96/018. NTIS PB96-963505.

U.S. EPA. 1996b. *Soil Screening Guidance: Technical Background Document.* Office of Emergency and Remedial Response, Washington, DC. EPA/540/R-96/128. NTIS PB96-963502.

U.S. EPA. 1997, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination*, Office of Emergency and Remedial Response, Offic of Radiation and Indoor Air, Washington, D.C., OSWER No 9200.4-18.

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# Attachment 6

# Operable Unit Cleanup Levels Matrix

**Attachment 6**
**Operable Unit Cleanup Levels Matrix**

| OU | Contaminants of Concern | Cleanup Levels | | | Note any Changes to Cleanup Levels | Remedial Action Objectives |
|---|---|---|---|---|---|---|
| | | Soil | | Groundwater | | |
| | | Residential | Industrial | | | |
| I | Cesium-137 | 23 pCi/g | 67 pCi/g | | | Prevent or minimize: 1. Leaching of contaminants from soil into groundwater, 2. Human exposure from surface and subsurface soil, 3. Uptake to ecological receptors. Rad soil cleanup levels are based on 15 mRem/year above background. The State ALARA goal is 10 mRem/year above background. |
| | Strontium-90 | 15 pCi/g | 15 pCi/g | 8 pCi/L | | |
| | Radium-226 | 5 pCi/g | 5 pCi/g | | | |
| | Lead | 400 mg/kg | | | | |
| | Mercury | 1.84 mg/kg | | | | |
| | 1,2-Dichloroethane | | | 5 µg/L | | |
| | Chloroethane | | | 5 µg/L | | |
| II | Cesium-137 | 23 pCi/g | 67 pCi/g | | | Documented in the OU I and III RODs. |
| | Tritium | | | 20,000 pCi/L | | |
| | Sodium-22 | | | 400 pCi/L | | |
| III | 1,1,1-Trichloroethane | | | 5 µg/L | | 1. Meet MCLs for VOCs and tritium in Upper Glacial aquifer within 30 years, 2. Meet MCLs for VOCs in Magothy aquifer within 65 years, 3. Meet MCLs for Sr-90 in Upper Glacial aquifer within 40 years and 70 years at Chemical Holes and BGRR/WCF plumes, respectively. |
| | Tetrachloroethylene | | | 5 µg/L | | |
| | Carbon tetrachloride | | | 5 µg/L | | |
| | Tritium | | | 20,000 pCi/L | | |
| | Strontium-90 | | | 8 pCi/L | | |
| | PCBs | 1 mg/kg - Surface NYSDEC TAGM | 10 mg/kg - Subsurf. NYSDEC TAGM | | | |
| IV | Ethylbenzene | | | 5 µg/L | | Restore groundwater quality to MCLs or background, and prevent or minimize: 1. Leaching of contaminants from soil into groundwater, 2. Human exposure from surface and subsurface soil, 3, Uptake of contaminants in soil by plants and animals. |
| | Toluene | | | 5 µg/L | | |
| | Strontium-90 | | | 8 pCi/L | | |

**Attachment 6**
**Operable Unit Cleanup Levels Matrix**

| OU | Contaminants of Concern | Cleanup Levels | | | Note any Changes to Cleanup Levels | Remedial Action Objectives |
|---|---|---|---|---|---|---|
| | | Soil | | Groundwater | | |
| V | Mercury | 2 mg/kg | | | | Protect public health and the sole-source aquifer, monitor the groundwater, and prevent or minimize: 1. Migration of contaminants present in surface soil via surface runoff, 2. Human and environmental exposure from surface and subsurface soil, 3. Reduce site-related contaminants (e.g., mercury) in sediment to levels that are protective of human health, 4. Reduce or mitigate, to the extent practicable, existing and potential adverse ecological effects of contaminants in the Peconic River, 5. Prevent or reduce the migration of contaminants off BNL property. |
| | Cesium-137 | 23 pCi/g | | | | |
| | Trichloroethene | | | 5 µg/L | | |
| VI | Ethylene dibromide | | | 0.05 µg/L | | 1. Meet MCL for EDB in the Upper Glacial aquifer within 30 years, 2. Prevent or minimize further migration of EDB in groundwater vertically and horizontally. |
| g-2/BLIP | Tritium | | | 20,000 pCi/L | | 1. Prevent additional rainwater infiltration into activated soil shielding, 2. Inspect and maintain the caps and other stormwater controls at the source areas, 3. Conduct groundwater monitoring to verify the effectiveness of the stormwater controls, and monitor the downgradient portion of the g-2 plume until tritium concentrations decrease to below the MCL. |

**Attachment 6**
**Operable Unit Cleanup Levels Matrix**

| OU | Contaminants of Concern | Cleanup Levels | | | Note any Changes to Cleanup Levels | Remedial Action Objectives |
|---|---|---|---|---|---|---|
| | | Soil | | Groundwater | | |
| BGRR | Strontium-90 | ALARA (1) | ALARA | 8 pCi/L | | 1. Ensure protection of human health and the environment from the potential hazards posed by the radiological inventory that resides in the BGRR complex, 2. Use ALARA while implementing the remedial action, 3. Implement long-term monitoring, maintenance, and institutional controls to manage potential hazards. |
| | Cesium-137 | ALARA | ALARA | | | |
| HFBR | Strontium-90 | 15 pCi/g | 15 pCi/g | 8 pCi/L | | 1. Control, minimize, or eliminate:1. All routes of future human and/or environmental exposure to radiologically contaminated facilities or materials, 2. The potential for future release of non-fixed radiological or chemical contamination to the environmen, 3. All routes of future human and/or environmental exposure to contaminated soils, and 4. The future potential for contaminated soils to impact groundwater. |
| | Cesium-137 | 23 pCi/g | 67 pCi/g for WLA | | | |

Notes:
pCi/g = picocuries per gram
pCi/L = picocuries per liter
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
TAGM = Technical and Administrative Guidance Memorandum
BLIP = Brookhaven Linac Isotope Producer
BGRR = Brookhaven Graphite Research Reactor
HFBR = High Flux Beam Reactor
ALARA = As Low as Reasonably Achievable

OU = Operable Unit
WLA = Waste Loading Area
MCL = Maximum Contaminant Level
EDB = Ethylene dibromide
VOC = Volatile Organic Compound
ROD = Record of Decision
WCF = Waste Concentration Facility